MARCH 1952 · Volume 67 · Number 3

PUBLIC HEALTH REPORTS

In this issue

FEDERAL SECURITY AGENCY • PUBLIC HEALTH SERVICE

Most hospitals, large and small, recognize the value of a favorable first impression and are trying to provide attractive main entrances, lobbies, and waiting rooms. The confidence which can be inspired through approaching a dignified, inviting entrance and entering a comfortable lobby can have a favorable therapeutic effect throughout a patient's course of treatment. A well-designed hospital with pleasant interiors is also much more likely to create community pride and support. This is the entrance and lobby of the Perry County hospital at Marion, Ala.

March 1952

Volume 67
Number 3

PUBLIC HEALTH REPORTS

Published since 1878

Contents

PUBLIC HEALTH REPORTS

FEDERAL SECURITY AGENCY
OSCAR R. EWING, *Administrator*

PUBLIC HEALTH SERVICE
LEONARD A. SCHEELE, *Surgeon General*

The Health Department's Dilemma

——*Definitions and Functions*——

By JOSEPH W. MOUNTIN, M.D.

From time to time, the public health profession, and particularly the health department, finds it necessary to redefine its field. The need for a new definition seems to strike us when there are substantial changes in problems and especially when major readjustments are in the making. This mid-century point is obviously one of those times, because many of the old problems have been resolved and because new opportunities for advancing human health are opening up constantly.

A definition, it may be mentioned at the outset, may be philosophical or broadly descriptive; or it may tend to fix boundaries. In the sense, however, that definitions help us clarify and delimit our responsibilities, they have much more than an academic or abstract interest for public health workers. They are the basic tools in determining the direction and scope and value to society of health programs. Certainly those of us who are administering a health program can appreciate the need for delineating functions and responsibilities. Wisely conceived and properly interpreted, a definition can serve a very useful purpose. But if a definition merely serves to restrict health departments, that is, if it is used to shut them out of current problems and activities, it can also be stultifying.

This brings us to a fundamental question: Can we ever hope to arrive at a definition that will give us a focus of operations and yet not be completely limiting? Many health workers know from their own experience how the act of setting boundaries often serves as an obstacle to the progressive development of services. Although the way out of this dilemma may not be readily discernible, we should be able to recognize its complexity and the reasons for its existence.

Dynamics of Public Health

The content and scope of health services, like society itself, undergo constant change. As old problems are solved or fade into minor significance, new ones or those unappreciated in the past arise to take their place. If we attempt to arrive at a frame of reference that will be meaningful in terms of specific health department responsibilities, it becomes obvious that no single concept can answer all our needs. It is almost impossible, in other words, to arrive at a definition that will be enduring and universal. The concepts that were appropriate some years ago do not—nor can they be expected to—take cognizance of current health problems and responsibilities.

On the other hand, an accurate description of public health in this country today would hardly be valid for vast areas of the world. In many parts of the world the absence of simple

Dr. Mountin is chief of the Bureau of State Services, Public Health Service. *This article is based on a paper read at the fifth annual meeting of the Massachusetts Public Health Conference and the New England Health Institute in Amherst, Mass., on June 15, 1951.*

personal and community hygiene underlies most of the health problems, and such diseases as malaria, intestinal disorders, and tuberculosis account for a very high proportion of deaths and disability. It would be necessary to go back, therefore, as much as a century in our own history to seek a suitable content for health programs in underprivileged parts of the globe today.

Public Health in Retrospect

Certainly up to the turn of the century our measures for meeting health needs even in this country, although realistic and effective, were little more than introductory. If public health had followed the comprehensive approach embodied in the Shattuck report (*1*), we might, from the very start, have moved forward on a much broader front than sanitation and infectious disease control. For example, this is what public health meant to Shattuck and his associates over 100 years ago: "The condition of perfect public health requires such laws and regulations, as will secure to man associated in society, the same sanitary enjoyments that he would have as an isolated individual; and as will protect him from injury from any influences connected with his locality, his dwelling house, his occupation, or those of his associates and neighbors, or from any other social causes." The emphasis on man as a social being and as a product of a social environment is amazingly modern.

But the dramatic effects of water purification and sewage disposal on human health were too compelling to be ignored. As a result, public health became set on the road it was to follow for the next 50 years and more—essentially the sanitation of the physical environment.

This is not to deny that environmental sanitation was an indispensable first step. The public health pioneers were fully attuned to the realities of their day. It was the slums and dirt, the overcrowded and inadequately safeguarded living conditions, and the poorly disposed, disease-bearing sewage and wastes that constituted the greatest menace to health in those days. The early leaders may have been vague as to etiology and imprecise as to control techniques. But they were crystal clear about the conditions they wanted combated through organized social action. And it was in response to those needs that organized public health programs developed and that professional responsibilities began to be recognized.

But the needs and the acquisition of new knowledge soon outgrew the original concepts. Public health began to acquire a systematized body of knowledge and experience that enabled it to shift its attention to preventive personal medicine and to tackle environmental hazards with increasing precision. The first decades of this century saw the beginnings of this new type of public health campaign, with its attention to the childhood ailments and the concerted attacks on the infectious diseases. The rapid development of bacteriology had brought many new techniques which enabled us to go beyond quarantine and disinfection, for a long time the principal measures for limiting the spread of contagion. Immunization against a wide range of diseases became possible and specific serums gave us our first effective therapy against many illnesses. The early decades of this century also saw the beginnings of the science of nutrition, which changed the course of control for several diseases. Finally, they were characterized by the development of considerable specialization, both in professional disciplines and in health services.

In these decades public health agencies exerted strong leadership by stimulating the new programs and using the new techniques. The efforts to prevent and control epidemics, to curb such diseases as diphtheria, smallpox, and typhoid fever met a real, demonstrated need of the people. And it was in answer to this need that modern local health organizations began to grow.

It was, in fact, out of this period that our current ideas of public health services evolved—concepts that included a "categorical" approach to disease, specific control techniques, and specialized, even compartmentalized services. As another result, public health workers began to give thought to the organizational structure for conveying services to the people. We began, thus, to acquire rather firm ideas about "basic" responsibilities and services, and about minimum standards of personnel and organization. And these concepts, once highly appropriate,

still cling to our consciousness in the face of changing conditions and altered needs.

New Needs and Directions

That the needs and the problems have changed substantially even within the last decade does not, I am sure, require much documentation. Many of the once most-feared infectious diseases are now negligible problems. The rapid development of antibiotic therapy has reduced the importance of most of those that remain to minor clinical entities. Moreover, the eradication of some transmissible diseases by mass therapy now looms as a distinct possibility. Syphilis is a case in point. In addition, public understanding about personal hygiene, sanitation, and the control of communicable diseases has progressed hand in hand with the improvements in knowledge and methodology.

Nevertheless, there are today many areas of unfinished business in public health—and even more important, many which are not yet started. The factors which have given rise to them are, of course, well known. The general aging of the population, the increase in chronic diseases, the problems associated with our complex industrial and social environment, all combine to create a new setting for public health.

In addition, a new approach to health itself is being fostered by professional groups as well as in the popular mind. Health is now being thought of, not in terms of disease or mortality figures, but in a positive way, in terms of physical fitness, mental and emotional adjustment, and social satisfaction and usefulness. In other words, health is no longer considered solely as an end, but also as a means. The public health responsibility cannot be considered liquidated once we have reduced infant mortality to the vanishing point, or conquered malaria or syphilis, or even cancer and heart disease. It must be geared to promoting ever higher standards of human efficiency and satisfaction.

As an important corollary of this approach, public health workers are obliged to take a new look at the origins of social pathology. Health problems cannot be isolated from the environment—both physical and social—in which they exist. Such factors as the individual's job, his family life, his housing, his recreation must all be assayed for their impact on health and disease. In other words, we must now not only put emphasis on the individual and his needs, but also consider him in relation to his whole complex socioeconomic environment.

This brief review of the major trends in the historical development of public health in this country suggests a conclusion that is already well known, that public health is dynamic and progressive. It develops at different rates of speed, depending upon differences in time, place, and problem. And, up to the present at least, the solution of one problem has only sharpened our awareness of needs in new or neglected areas.

Limitation by Definition

The progressive nature of public health makes any restricted definition of the functions and responsibilities of health departments difficult. More than that—there is a real danger in attempting to narrow down a moving and growing thing. To tie public health to the concepts that answered our needs 50 years ago, or even a decade ago, can only hamstring our contribution to society in the future.

Consider the results if the public health profession had fixed or solidified its responsibilities during any of the earlier periods just noted. Perhaps we would still be concentrating on gross environmental sanitation or, if our program became static at a later period, we would still be limited to placarding and fumigating. Even if our responsibilities had crystallized as much as a decade ago, we would have practically no cancer control or mental health programs today. These and many other recognized activities would be ruled out if we truly limited public health programs to the so-called basic six—the minimum functions which have been suggested for local health departments; nor would there be any room for an aging or a hygiene-of-housing program in the future.

In allowing itself to be guided by a limited definition, public health may fall into the error of substituting the symbol for the job, of mistaking the contrived concept for the actual responsibilities that the people want met. This becomes the start of a descent. The next step,

the one that is far more dangerous, is to live down to the artificial symbol instead of living up to the actual job.

If a public organization or agency is not alert to changing needs, if it grows insensitive to the desires of the people, it becomes rigid and actually falls behind the times. It not only tends to lose popular support but fails to attract the kinds of professional personnel it needs to carry on its programs. Moreover, a narrow outlook constitutes an open invitation for new programs to spring up under other auspices, which may be less well equipped in terms of professional competence and technical experience.

For example, how many health programs have gone by default to other governmental agencies because the health department was not ready to modify or redirect its efforts? A 1950 sample survey of the distribution of State health services (*2*) reveals that in at least one State, 23 State agencies are administering important health functions and that in no State are these activities administered by less than nine. This extreme dispersion is even more pronounced when we examine some of the newer programs individually. For example, in a single State as many as seven different agencies are engaged in some kind of accident prevention programs. Similar situations exist in such fields as water pollution control, hospital planning and construction, mental health, and the administration of medical care programs.

I am not suggesting that all public health services need be the exclusive province of the official health department. Far from it. In our complex civilization, many organizations—voluntary as well as official—have an important role to play. But I think the figures are significant in that they reveal the health department's reluctance to sponsor new services or to accept new areas of interest, despite the fact that these services fill a demonstrable void on the local scene.

A Modern Concept of Services

The question may still be asked: Are there any guidelines which we can use in determining current services and responsibilities of health departments and at the same time avoid being restrictive? The answer is "yes," provided the guidelines are kept flexible and leave room for future modification of program content. In its recent revision of the functions and responsibilities of the local health department, the American Public Health Association (*3*) noted that the rapid development of health services has caused the definitions of local health services and responsibilities "based on limited categories of activity" to become "quickly outdated." They recommended instead that "optimal" responsibilities be identified and that health department services be expressed in general terms. Seven general types of service are listed, namely, the recording and analysis of health data, health education and information, supervision and regulation, provision of direct environmental health services, administration of personal health services, operation of health facilities, and coordination of activities and resources.

On looking at this list, one's first impulse is to say that seven services have now been substituted for six. But the differences are far more important than the addition of a new responsibility. The earlier statements identified specific programs or functions whereas the new listing indicates general areas of service, under which one or several programs may be included. The term "basic" or "essential" may imply that other services are little more than frills; and as a result minimum functions soon become the major or the sole activities of the health department. The broader approach opens up the road for a thrust in any direction, depending on where the greatest need exists.

The transition from a concept of "basic" services to one of "optimal" services is an extremely important one. It raises our sights far above the routine and static activities that still characterize too many health departments. It means a recognition of the realities of the day. And it implies the readiness, the willingness, and the competence to step in and take some positive action wherever a health problem exists and is being neglected.

On the other hand, this approach is not one of unlimited expansionism. It is not a matter of simply adding one job on top of another until we amass a long string of impressive responsibilities. At least two factors should militate against such a mushroom type of growth.

The first is that public health is and should continue to be subject to social controls which will effectively prescribe our areas of responsibility. It is one thing to say that public health should not be impeded by definitions that are designedly restrictive. It is another to recognize that public health must adapt itself to the will of the community. Such practical matters as budget and fiscal considerations—sometimes looked on as the bane of our existence—actually provide the opportunity for considered review of our activities. On these occasions, too, representatives of the people reflect the community's needs, problems, and desires for service. In a democratic society, we can rely on social controls for the guidance and advancement of public programs, but only if these controls are allowed to operate freely.

The second factor involves the recognition by public health agencies of an important obligation. They owe it to society to modify or reduce those activities which may be marked as finished business or as business that offers only limited returns on the investment. For example, many commercial organizations as well as consumer groups are now deeply aware of health and sanitation measures and put them into daily practice. Restaurants and food establishments are beginning to undertake programs to supervise their own sanitation. The housewife insists on a clean butcher shop and grocery store. Because this is so, health department staffs no longer need conduct the same kinds of detailed inspection and regulatory programs that were formerly the rule.

Food-borne outbreaks of disease must undoubtedly be guarded against vigorously. In fact, a great many such outbreaks still occur each year. But health departments might prevent these occurrences by a program of general education and standard setting and by the training of food handlers, supplemented by judicious law enforcement. Particularly where they are operating within a limited budget, they might rely on spot checks and on more precise information about outbreaks now taking place rather than on the general purpose inspection. In such a manner, they might meet the problem more effectively and at less cost and, by the same token, make more time and money available for other activities. Sanitarians could devote more of their energies to contemporary problems in food sanitation and to other new fields, where their experience and training can be put to good use. They might, for example, be working on such broad social problems as community planning, housing, control of air pollution, and accident prevention.

Somewhat the same situation holds true for the programs designed to improve individual and family health. Many of the time-consuming activities involved in controlling some of the infectious diseases may be modified to a holding type of operation—that is, maintaining vigilance against localized outbreaks of disease. On the other hand health departments must turn more attention to other types of personal health services.

Opportunities Unlimited

Preventive health work no longer means solely safeguarding the physical environment or curbing the spread of infection. Today it has a personal connotation and, even more, it means preventing the complications of disease or the further deterioration of one who already has a disease or disability. In the words of the official APHA statement (*3*): "Because of the marked changes in the age distribution of the population and in the spectrum of our health problems, the theory and practice of public health has expanded to include not only prevention of the onset of illness, but also prevention of the progress of disease, of associated complication, and of disability and death."

Perhaps because there are relatively few primary preventive measures against the chronic impairments, the role of the health department in this field has not yet been clearly established. There are, however, many ways in which the actual or potential resources of the health agency may be utilized. These vary all the way from providing auxiliary services for physicians in private practice to operating the facilities which may be established under public auspices for general or specialized care.

Medical care is also beginning to exhibit many of the elements which are identifiable with a general health service. This is so partly because of the increased effectiveness of therapeutic measures which can be used to combat

certain diseases on a mass basis. The effects of modern therapy on scarlet fever and pneumonia demonstrate graphically how these diseases have been robbed of most of their terrors. There are other, if less dramatic, examples. The new "wonder drugs" not only reduce mortality strikingly but also abort many incipient cases of disease; almost without exception they shorten morbidity and reduce complications. Thus, the health department must be increasingly concerned with the character and availability of medical facilities and services within its geographic area.

Even with our limited knowledge today, much can be done not only to stabilize chronic illness but also to rehabilitate its victims and to help them make necessary adjustments. In light of the social goals of public health, it is our responsibility to play an active part in restoring an individual to his family, his job, and his community. Any recovery or any gain that will make a person in any measure more self-sustaining than he was will mean some degree of improvement, not only for the individual but for society. Even if an individual is rehabilitated from the hospital bed to the wheel chair at home, it represents that much of a social gain in relieving the community of the burden, the expense, and the responsibility of care. If the person is able to return to productive employment, the gains are multiplied many times over.

The Pioneering Spirit

Can health departments assume these new responsibilities without undergoing a major upheaval? I think they can, provided there is a recognition of the need, a reorientation of thinking, and a willingness to tackle the job. The new approach will call for a great deal of administrative and technical pioneering. For example, from our experiences in controlling the diseases of bacterial origin, we are used to dealing with specific, almost rigid, control techniques. For our purposes today, however, we may have to revert once more to the rather general approach reflected in the Shattuck report (*1*). In such programs as health promotion for older people or mental health, we are dealing with a new kind of social pathology, much of which is still vague and ill-defined. Thus, we may very well turn to empirical and general methods, at the same time seeking constantly for refinements and for more precise techniques.

The health department can begin preparing for its new responsibilities by surveying the resources and facilities already available in the community and by being ready to adapt or to apply them to health purposes. It must seek and train a wide variety of new competencies and make liberal use of consultants. Cardiologists, psychologists, medical social workers, nutritionists, even economists and sociologists, all have a place in modern health service programs. Although not all of them can or should be employed directly on the staff of every local health department, an interchange of personnel can be made possible through the regionalization of health services. In addition, a progressive program of staff education should be instituted to give professional personnel the broad perspective and well-rounded knowledge they need to conduct the newer health programs. Training should be given not only in the traditional health field but in a variety of related disciplines and particularly in the social and administrative fields.

Moreover, the health agency should call for consultation and advice from people both within and outside the health professions. Engineers and safety consultants as well as epidemiologists, psychiatrists, health educators, and public health nurses have much to contribute to a program in the prevention of home accidents. Social workers, recreational personnel, industrial and labor groups, and housing officials all have to play a part in programs designed to promote the health of older people.

It would seem clear, therefore, that the health department today is only one of a number of agencies—official and nonofficial—which can contribute toward better health. Many of the newer programs must be based on suitable working arrangements between health departments, hospitals, private physicians, and others who actually perform various services.

Other types of administrative reforms and organizational improvements will undoubtedly suggest themselves to health workers once they take the initiative in developing the new programs. What is important to remember is that

a variety of activities are already under way. Excluding health departments by definition merely precludes them from participating in many services where they have much to offer. If health workers remain wedded to concepts unrelated to current needs, health department programs will inevitably be sterile and narrowly restricted. If, however, they not only meet these needs but also keep in mind the broader objectives—improving individual satisfaction and community life—they will be ready to make their maximum contribution to society.

For despite all the health activity that is going on today and despite all the real progress that is being made, there is a greater need than ever for a community organization to spearhead the work and to provide the technical and administrative guidance. That organization should be the focal point of the community's health activity. It should contain the social perspective and the wealth of competency to be able to perceive the need; and it should have the ability and the courage to take whatever action is necessary.

The people expect the health department to be that organization. They look to it as the community agency which will help find the answers to their pressing health problems. It is to this trust that public health must be truly dedicated.

REFERENCES

(*1*) Shattuck, Lemuel, and others: Report of the Sanitary Commission of Massachusetts, 1850. Cambridge, Harvard University Press, 1948, p. 10.

(*2*) Mountin, Joseph W.: Changing patterns of State health services. Am. J. Pub. Health 41: 516–521 (1951).

(*3*) American Public Health Association: The local health department—Services and responsibilities. Am. J. Pub. Health 41: 302–307 (1951).

Parrot Fever Quarantine Revised

Revisions in the Federal quarantine regulations for the foreign importation and interstate shipment of parrots, parakeets, lovebirds, and other psittacine birds have been announced by the Public Health Service.

Changes in the foreign quarantine regulations went into effect December 15, 1951. They remove the 8-month minimum age limit on birds imported for use by zoos and research; reduce from 2 years to 4 months the time birds imported as pets must be in the owner's possession prior to entry into this country, and remove the requirement that imported pet birds must be transported to the owner's residence immediately upon arrival in this country. An added requirement is an affidavit that birds imported as pets are not to be resold and that the owner has brought no other birds into the country during the preceding year.

Changes in the interstate quarantine regulations, which went into effect November 15, 1951, remove all Federal restrictions on shipments of psittacine birds from psittacosis-free areas in the United States, but they prohibit the shipment of the birds from areas where the Public Health Service has determined that psittacosis infection is dangerous to the public health.

None of the changes affect the standing requirement that interstate shipments of psittacine birds must be covered by a permit when it is required by the health department of the State of destination.

Changes in the quarantine regulations followed a Public Health Service study which disclosed that psittacosis is no longer a major public health problem in this country and that the disease is found among birds which do not belong to the psittacine family.

985891—52——2

Lead Poisoning in Young Children

By HUNTINGTON WILLIAMS, M.D., EMANUEL KAPLAN, Sc.D., CHARLES E. COUCHMAN, and R. R. SAYERS, M.D.

Lead poisoning in young children associated with eating lead-containing paint has been increasingly recognized until it ranks as one of the most common causes of child mortality due to poisoning. However, lead poisoning is not a reportable disease and, therefore, there is a lack of adequate morbidity data (*1*). The widespread occurrence of lead poisoning throughout the United States and Canada is evident from reports of cases in which eating lead-containing paints was mentioned as the cause of poisoning in infants and young children (*2–37*). Although 19 different communities are mentioned, most of the cases were from large cities such as Baltimore and Boston, where children's hospitals or local health authorities were especially interested in the problem. During the period 1931–40, the city of Baltimore alone reported 24.3 percent of all the child deaths from lead poisoning reported from the entire United States registration area (*1*). From January 1, 1931, to June 30, 1951, a total of 293 cases of lead poisoning was reported in Baltimore children. Of these, 83 died (*2*).

The most common cause of lead poisoning is apparently the habit of chewing paint from cribs, toys, furniture, woodwork such as window sills, and the eating of painted plaster and fallen paint flakes. The tendency to put things in the mouth, though normal in the first year of life, is considered abnormal if continued into the latter part of infancy, and is referred to as pica, or perverted appetite (*6, 30*). Pica is the usual forerunner of lead poisoning.

Although pica does not exist on a seasonal basis, a striking number of lead-poisoning cases resulting from this habit occur in the hot summer months. For this, no satisfactory explanation is available, although several investigators have commented on the tendency for lead poisoning to occur in children during the warmer weather (*2, 21, 26, 37–40*).

Dr. Williams is commissioner of health of the Baltimore City Health Department; Dr. Kaplan is chief of the division of chemistry; Mr. Couchman is director of the bureau of industrial hygiene; and Dr. Sayers, a medical director (retired) of the Public Health Service, is senior medical supervisor of occupational diseases. For several years he was director of the Bureau of Mines, Department of the Interior.

Diagnosis, Prognosis, and Sequelae

Unrecognized plumbism, lead poisoning, in children may explain many obscure nervous conditions and convulsions of undetermined etiology (*12, 22*). Errors have been made in operating on cases presenting symptoms indicating a need for surgery but which were caused by lead intoxication (*14, 31*).

Lead poisoning is cumulative. Some weeks or months following the continued ingestion of small amounts of lead, symptoms begin to appear. Early symptoms may be only irritability, fretfulness, or disturbed gastrointestinal function characterized by lack of appetite, constipation, vomiting, or cramps. A secondary anemia with resulting pallor is often present. More severe intoxication results in lead en-

cephalitis due to increased intracranial pressure because of cerebral edema. The acute stages of the disease are manifested in changes in mental state, ataxia, persistent vomiting, muscle weakness or paralysis, delirium, stupor, coma, convulsions, and, not infrequently, death.

Diagnosis involves correlation of a history of paint-eating or pica with the physical findings, laboratory and X-ray data. The importance of eliciting a history of pica cannot be overemphasized in the early recognition of the disease. Examination of blood smears often shows stippling of the red blood cells. Porphyrinuria is frequently found. The demonstration by roentgenogram of an increased density in the growing ends of the long bones is a cardinal sign of lead poisoning (*34*). In recent years, the quantitative determination of lead in blood or urine as an index of abnormal lead absorption has proved an invaluable aid in diagnosis (*41*, *42*). Lead poisoning in children differs considerably from the disease in adults. Central nervous system involvement or encephalopathy, rarely seen in adults, is common in children, whereas peripheral neuritis, lead line on the gums, and colic are usually absent.

The prognosis in lead encephalitis in children is poor; the high mortality rate, as well as the incidence of severe, lifelong, residual nervous system injury, has been commented on by many investigators (*25*). The mental development of even the less severe cases may be seriously impaired (*16*).

Baltimore Experience

Thomas and Blackfan (*3*) of the Johns Hopkins Hospital were the first to point out in American pediatric literature the frequency of occurrence of lead encephalopathy in children. Subsequently, studies at the same institution provided pioneer information on the diagnosis (*4*, *26*, *34*, *42*) and treatment (*25*, *40*) of plumbism in infancy. The Baltimore City Health Department in 1932 began studies of nonindustrial lead poisoning in children in an investigation of cases resulting from the use of storage battery casings for fuel (*43*). Afterwards, all cases of lead poisoning brought to the attention of the department were routinely investigated to ascertain the source of the lead.

Blood-Lead Laboratory Service

As an aid in diagnosis, since early in 1935, the bureau of laboratories of the Baltimore City Health Department has maintained a free routine analytical service for the quantitative estimation of lead in the blood of cases of suspected plumbism (*41*). The dithizone method is used. Especially prepared lead-free blood specimen collection containers known as "blood-lead outfits" are distributed to the local hospitals and physicians in the same manner as outfits regularly provided for specimens in cases of communicable diseases.

Since 1935, almost 3,000 specimens of blood from about 1,800 children have been tested for lead. Increase in this service, as well as the increased number of cases diagnosed during the last 4 years in contrast to the preceding 13 years, is shown in the accompanying table. Undoubtedly, the improved educational activities in lead poisoning prevention in recent years have been a prominent factor in this increase.

Comparison of blood-lead laboratory service tests and cases of lead poisoning in Baltimore children for the periods 1948–51 and 1935–47

Period	Number children given lead test		Diagnosed cases of lead poisoning	
	Total	Average per year	Total	Average per year
1948–51 (4 years)	1,007	252	166	41
1935–47 (13 years)	772	59	161	12.4

Field Investigation

Field work, associated with a follow-up of the blood-lead laboratory service, has enabled the Baltimore City Health Department to acquire relatively accurate data concerning the incidence of lead poisoning in the community (*1*). A report of each blood analysis was forwarded to the bureau of industrial hygiene, which investigated cases in which the blood showed an abnormal absorption of lead. The

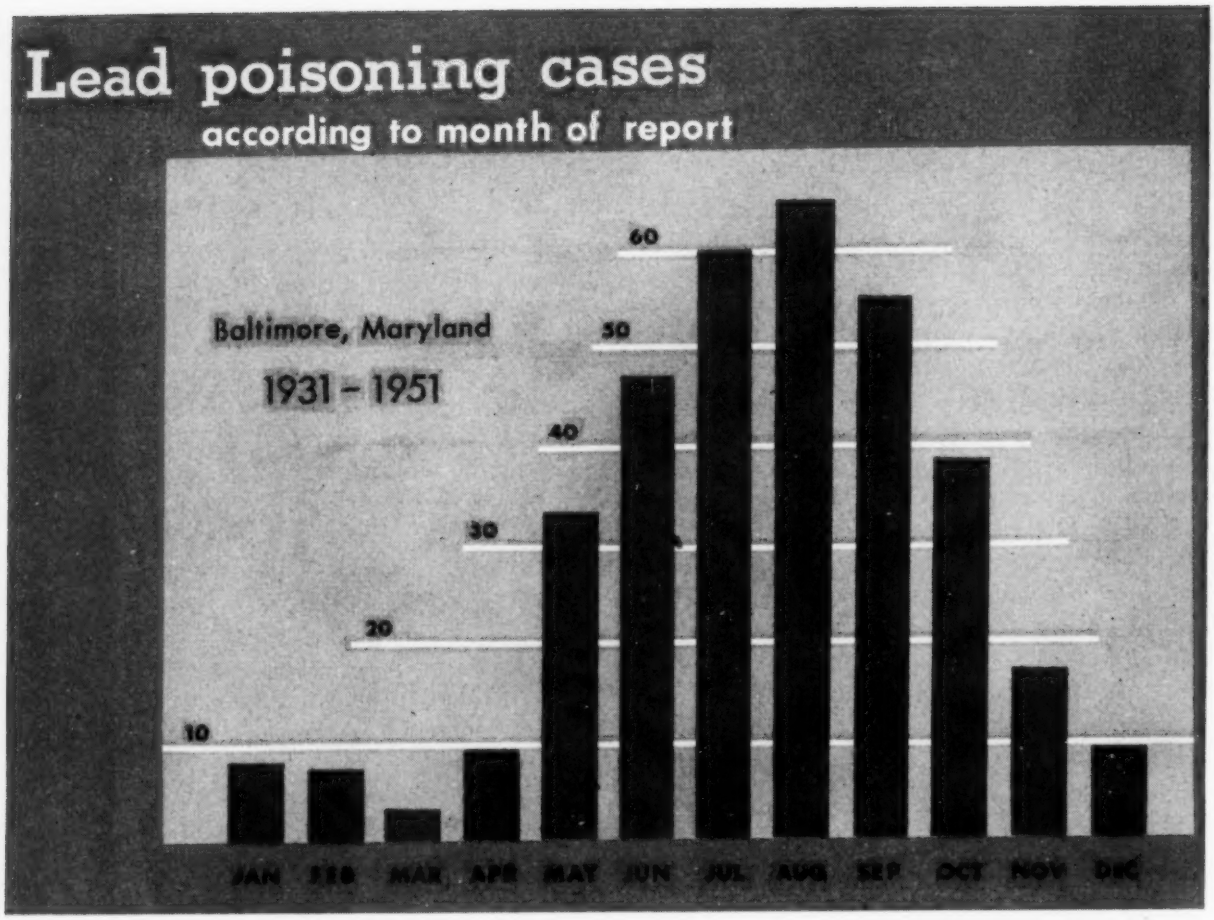


Figure 1. Lead poisoning cases reported in Baltimore, according to month of report, 1931–51.

upper limit of normal is considered to be 0.05 to 0.06 mg. percent of lead. Adequate clinical and laboratory data were usually available because nearly all of the children were diagnosed and treated in hospitals.

After learning the medical history, a field worker visited the home of the affected child to obtain pertinent information, particularly concerning exposure to lead. Almost without exception, the cause of poisoning was found to be pica associated with the ingestion of paint. This was confirmed at the time of the home visit by obtaining for analysis a sample of paint scrapings, approximately 0.5 to 1 gm., from surfaces where the child had chewed paint.

Lead Poisoning in Children

Over the past two decades, 347 cases of lead poisoning have been diagnosed in Baltimore children. These do not include the storage battery cases referred to earlier. Of the 347 cases, 54 have been reported since June 30, 1951. A study of these cases has led to the discovery of interesting patterns in the seasonal incidence of the disease, age and color distribution of the children, and the types of houses involved. It is evident from figure 1 that more cases were reported in July and August than in any other months. There was no significant difference in incidence between sexes. Sixty percent of the cases occurred among children in their second year of life, at teething age, when they have a greater tendency to put things into the mouth. Only 2.3 percent of the cases were in children above 5 years of age.

The annual attack rate for the age segment under 5 years during the period 1931–51 was 7.5 times as high among the Negro population (71 per 100,000) as it was among the white

population (9.5 per 100,000). When the more recent experience of the past 4 years is considered, the attack rates for both white and Negro children as well as the difference between races are significantly elevated above the average experience cited. The high rates among Negro children are a problem of considerable public health significance since 30 percent of Baltimore's preschool population is Negro. The racial difference in incidence is believed to be due to environmental factors probably resulting chiefly from economic disadvantage.

For the past few years information has been collected on home ownership in neighborhoods where child lead poisoning cases occurred. Almost 90 percent of the houses were tenant-occupied. In the early years of the study some of the cases arose in well-kept property, but with the continued community education by press and radio, cases in this category have become relatively rare. The problem in Baltimore at present involves chiefly slum or blighted-area properties. The cases are concentrated in two areas which are of known slum status and where the houses are old and have had many coats of paint, usually lead paint, applied throughout several decades. A typical home where a case of lead poisoning occurred is shown in figure 2.

Methods of Prevention

Education and Publicity

In an effort to prevent lead poisoning, repeated public warnings about this child health hazard have been given by the Baltimore City Health Department in the press, by radio, and on television. The *Baltimore Health News*—mailed each month to over 10,000 persons, including 1,800 local physicians and 6,000 school teachers—devoted a number of issues (*2*, *46*, *47*) to the subject. The bureau of child hygiene issued a leaflet (*45*) entitled "Lead Poisoning in Children, a Disease You Can Prevent." The leaflet directs attention to 220 cases and 78 deaths from lead poisoning in Baltimore during the past 18 years, makes suggestions to parents for preventing children from contracting the disease, lists the warning signals to be watched for, and stresses the importance of early diagnosis and treatment.

It is not unusual now for a mother to take a child to a physician and to volunteer information on pica and suggest that the child may be suffering from lead poisoning.

The Public Health Nurse

One of the most promising advances in the prevention of child plumbism was the assignment several years ago of a public health nurse supervisor to investigate lead poisoning cases. With the knowledge gained by intimate association with the problem, the supervisor was able to interest other public health nurses. They not only make home visits and disseminate information in the most-affected areas of the city, but may take part in well-baby clinics, where mothers are told of the dangers connected with pica.

Lead Paint Removal

For the past 4 years, landlords of properties where lead poisoning has occurred have been notified, in accordance with the Baltimore ordinance on the hygiene of housing (*44*), to remove lead paint from the surfaces where there is flaking or where a child has chewed. Of 96 such notices during this period only 2 were not complied with in the time allotted. Both owners were summoned to the Magistrate's Court, where they were found guilty and fined; only then did they fully comply with the health department's orders. Many sanitarians on the health department staff who inspect property, primarily on the basis of other types of complaints or because of rodent and housing surveys, also require correction of a flaking paint condition in the notice sent to the property owner. The sanitarians are instrumental in the distribution to slum dwellers of the leaflet on the lead poisoning prevention (*45*).

Legislation

Because of the danger to small children, manufacturers of cribs and toys have for many years (*9*, *17*, *48*) used paints free of lead pigment.

For various reasons legislation against the use of lead paint has existed in widely separated jurisdictions for a number of decades. Germany has had a national law on the matter

Figure 2. House doorway in home of patient with lead poisoning.

since about 1900. Regulations prohibiting the use of lead-containing paints on toys, children's furniture, and for interior work have been enforced in France since 1917 (*17*). As early as 1922, the nations adhering to the International Labor Office in Geneva proposed a convention prohibiting the use of white-lead paint in interior painting of buildings as a health measure affecting painters (*49*). Since 1932, factory legislation in Ontario has required all lead-containing paints supplied to plants manufacturing children's toys and furniture to be so labeled (*17*, *48*). No cases of lead poisoning related to chewing on new furniture or painted toys have been reported in recent times. When such objects are involved, the source of lead has been repainted furniture—parents frequently use lead-base paints for repainting jobs. Nevertheless, the Maryland State Legislature in 1949 enacted chapter 517 of the Acts of 1949, which made it compulsory to affix a label to any toy or to any children's furniture decorated with paint or other material containing lead or any other poisonous substance, stating clearly the poisonous nature of the paint or decoration. Unenforceable, the law was repealed a year later.

On June 27, 1951, regulation No. 17 was adopted by the commissioner of health of Baltimore under the ordinance on the hygiene of housing. The text follows:

> *Interior Painting.* No paint shall be used for interior painting of any dwelling or dwelling unit or any part thereof unless the paint is free from any lead pigment.

The wording was studied carefully so as not to prohibit the use of paints containing either lead driers, usually present in amounts corresponding to less than 1 percent of lead in the finished paint, or pigments contaminated with

traces of lead. The use of the term "lead-free paint" was purposely avoided, since it is doubtful if the usual commercial product could be made without having a detectable amount of lead present. This regulation has had pronounced salutary effect as shown by an increasing interest on the part of home owners, health agencies, and local paint manufacturers, some of whom have recently advertised paints free from lead pigment.

Lead Content of Paint

The health department's suggestions to parents interested in the purchase of "lead-free" paint emphasizes a selection based upon the labeled composition of the product. Although there is no Maryland law on the subject, many of the paints sold locally contain a statement of composition on the label. Such labels provide information on the presence of lead-bearing compounds and are adequate except in those instances where the terms "chrome yellow," "chrome green," or "chrome orange" camouflage the fact that these pigments contain substantial amounts of lead chromate. For this reason, when inquiry is made, it has been recommended that no yellow, green, or orange colors be used in refinishing articles of furniture intended for use by children unless the pigment composition as declared on the label clearly excludes the presence of lead.

Summary

Lead poisoning in children caused by ingesting lead from surfaces coated with lead-containing paint is apparently widespread throughout many parts of the Nation.

The disease has a high rate of incidence in the city of Baltimore, where it occurs in children of teething age living in old, run-down rented properties where lead paint had been used indoors for many years.

Public health education, coupled with a "lead consciousness" on the part of physicians and the pediatric clinics of local hospitals, and with a blood-lead laboratory service offered by the city health department has resulted in a marked increase in case recognition.

It is hoped that the application of principles involving education and the enforcement of measures regulating the use of lead-containing paints will result in a material reduction and the eventual eradication of child lead poisoning in Baltimore City.

ACKNOWLEDGMENTS

The authors are indebted to Matthew L. Taback, director of the bureau of biostatistics, and to Margaret Galbreath, supervisor assigned by the bureau of public health nursing to the bureau of industrial hygiene, for assistance in the preparation of this article.

REFERENCES

(*1*) McDonald, J. M., and Kaplan, E.: Incidence of lead poisoning in the city of Baltimore. J. A. M. A. **119**: 870–872 (1942).

(*2*) Williams, Huntington: Lead poisoning killed 83 children. Baltimore Health News **28**: 113–116 (1951).

(*3*) Thomas, H. M., and Blackfan, K. D.: Recurrent meningitis due to lead in a child of five years. Am. J. Dis. Child. **8**: 377–380 (1914).

(*4*) Blackfan, K. D.: Lead poisoning in children with especial reference to lead as a cause of convulsions. Am. J. Med. Sc. **153**: 877–887 (1917).

(*5*) Strong, R. A.: Meningitis caused by lead poisoning in a child of nineteen months. Arch. Ped. **37**: 532–537 (1920).

(*6*) Ruddock, J. C.: Lead poisoning in children with special reference to pica. J. A. M. A. **82**: 1682–1683 (1924).

(*7*) McKhann, C. F.: Lead poisoning in children. Am. J. Dis. Child. **32**: 386–392 (1926).

(*8*) McKhann, C. F.: Lead poisoning in children. The cerebral manifestations. Arch. Neurol. Psychiat. **27**: 294–304 (1932).

(*9*) McKhann, C. F., and Vogt, E. C.: Lead poisoning in children. J. A. M. A. **101**: 1131–1135 (1933).

(*10*) Donnally, H. H., Schutz, C. A., and Nimetz, A.: Chronic lead poisoning in early childhood. Virginia Med. Monthly **62**: 83–89 (1935).

(*11*) Nicholson, W. W.: Lead poisoning in children. Kentucky Med. J. **33**: 180–181 (1935).

(*12*) Cushing, H. B.: Diagnosis of lead poisoning in children. Internat. Clin. 44th Series **1**: 189–195 (1934).

(*13*) Gant, V. A.: Lead poisoning. Chicago, Industrial Health Book Co., 1939, pp. 39–42.

(*14*) Bucy, P. C., and Buchanan, D. N.: The simulation of intracranial tumor by lead encephalopathy in children. J. A. M. A. **105**: 244–250 (1935).

(*15*) Kowaloff, I.: Lead encephalopathy. Am. J. Dis. Child. **61**: 547–556 (1941).

(16) Byers, R. K., and Lord, E. E.: Late effects of lead poisoning on mental development. Am. J. Dis. Child. 66: 471–494 (1943).

(17) Ross, R. J., and Brown, A.: Poisonings common in children. Canad. Pub. Health J. 26: 237–243. (1935).

(18) Parker, G. M. (Division of Industrial Hygiene, Toronto): Personal communication.

(19) Taylor, H. W., and Schram, M.: Abdominal symptoms of lead poisoning in children. Arch. Ped. 53: 182–186 (1936).

(20) Anonymous: Lead toys—lead paint—lead poisoning. Safety Education 22: 74 (1942).

(21) Rapoport, M., and Rubin, M. I.: Lead poisoning. A chemical and experimental study of the factors influencing the seasonal incidence in children. Am. J. Dis. Child. 61: 245–255 (1941).

(22) Netzley, R. E.: Lead encephalitis precipitated by acute infection. California West. Med. 46: 306–308 (1937).

(23) Golden, J. T.: Watch out for lead poison. The Cincinnati Inquirer, Sunday, August 12, 1951, p. 3.

(24) Goettsch, E., and Mason, H. H.: Glycosuria in lead poisoning. Am. J. Dis. Child. 59: 119–128 (1940).

(25) Ennis, J. M., and Harrison, H. E.: Treatment of lead encephalopathy with BAL (2,3-dimercaptopropanol). Pediatrics 5: 853–868 (1950).

(26) Blackman, S. S., Jr.: The lesions of lead encephalitis in children. Bull. Johns Hopkins Hosp. 61: 1–61 (1937).

(27) Dannenberg, A. M., Widerman, Arnold H., and Friedman, Paul S.: Ascorbic acid in the treatment of chronic lead poisoning. J. A. M. A. 114: 1439–1440 (1940).

(28) Haverfield, W. T., Bucy, Paul C., and Elonen, Anna S.: The surgical treatment of lead encephalopathy. J. A. M. A. 114: 2432–2437 (1940).

(29) Wilkinson, E. E.: Sodium citrate in treatment of lead encephalopathy. Texas State J. Med. 43: 442–445 (1947).

(30) Stetson, C. A.: Pica: Its relationship to lead poisoning in children. J. Maine Med. Assoc. 38: 10–12 (1947).

(31) Sibley, W. L.: Lead poisoning in infancy. A case in which two operations were performed on the stomach. South. Surgeon 15: 427–436 (1949).

(32) Akelaitis, A. J.: Lead encephalopathy. A clinicopathological study. J. Nerv. & Ment. Dis. 93: 313–331 (1941).

(33) McGovern, J. P., and Simmons, E.: Chronic lead poisoning associated with eosinophilia and splenomegaly. Clin. Proc. Child. Hosp. 6: 33–38 (1950).

(34) Park, E. A., Jackson, Deborah, and Kajdi, Laslo: Shadows produced by lead in the X-ray pictures of the growing skeleton. Am. J. Dis. Child. 41: 485–499 (1931).

(35) Seifert, H. E. (Virginia Bureau of Industrial Hygiene): Personal communication.

(36) McKhann, C. F.: Lead poisoning. *In* Brennemann's Practice of Pediatrics, Hagerstown, Md., W. F. Prior Co., Inc., 1948, vol. 1, ch. 18, p. 1–8.

(37) Feldman, H. T.: Lead poisoning. Salient features in its diagnosis and treatment. Clin. Proc. Child. Hosp. 7: 194–205 (1951).

(38) Brienl, A., and Young, W. J.: The occurrence of lead poisoning among North Queensland children. Ann. Trop. Med. 8: 575–589 (1914–15).

(39) Fukushima, M., and Matsumato, H.: Statistics of 298 cases of infantile lead poisoning. Oriental J. Dis. Infants 3: 27–31 (1928).

(40) Shelling, D. H., and Hopper, K. B.: Calcium and phosphorus studies. Bull. Johns Hopkins Hosp. 58: 137–211 (1936).

(41) Kaplan, E., and McDonald, J. M.: Blood-lead determinations as a health department laboratory service. Am. J. Pub. Health 32: 481–486 (1942).

(42) Blumberg, H., and Scott, T. F. Mc.: The quantitative spectrographic estimation of blood lead and its value in the diagnosis of lead poisoning. Bull. Johns Hopkins Hosp. 56: 276–293 (1935).

(43) Williams, Huntington, Schulze, W. H., Rothchild, H. B., Brown, A. S., and Smith, F. R., Jr.: Lead poisoning from the burning of battery casings. J. A. M. A. 100: 1485–1489 (1933).

(44) Baltimore ordinance on the hygiene of housing. No. 384, approved March 6, 1941, as amended by No. 902, approved March 29, 1943.

(45) Lead poisoning in children—A disease you can prevent. Baltimore City Health Department Leaflet, 1949.

(46) Lead poisoning in children. Baltimore Health News 14: 109–110 (1937).

(47) Lead poisoning in children is preventable and can be fatal. Baltimore Health News 26: 122–124 (1949).

(48) Jephcott, C. M.: Lead in certain colored chalks and their danger to children. Canad. Pub. Health J. 28: 391–393 (1937).

(49) Hamilton, Alice: Recent changes in the painters' trade. U. S. Department of Labor, Division of Labor Statistics, Bulletin No. 7, 1937, p. 40.

The Mental Hygiene of Aging

By PAUL V. LEMKAU, M.D.

Mental hygiene, the extending of satisfactions of living and the decreasing of the incidence and prevalence of mental disease, is as feasible for older as for younger groups. Two basic concepts underlie this belief: First, there is apparently no complete and direct relationship between the anatomical changes in the brain and the behavior of the personality possessing it; second, the capacity to function is lost when not exercised.

The first concept is illustrated by the fact that some persons with severe senile degenerative brain changes are able to exist outside of psychiatric hospitals, maintaining their behavior within the bounds tolerable to society. Others with no more severe changes, show behavior which cannot be tolerated and these must be hospitalized. The relationship between brain changes and behavior is influenced by the specific location of degenerative processes in the brain and by the extent of generalized loss of brain cells. If the loss is extreme, behavior must degenerate. If it is not extreme, the extent of change does not completely account for behavior alterations.

The most startling examples of the second concept, that functions atrophy when not in use, come from the period of early infancy and are described by Gesell (*1*), Bowlby (*2*), and others. An isolated child who hears no speech and is not encouraged to speak will not speak, and eventually becomes incapable of learning to speak. In the same way, the child deprived of the opportunity of forming social relationships will eventually lose the capacity to make such relationships.

In the animal world, status in the society has been shown to be relatively fixed by the "experiences" of the animal in question (*3*). The mouse, at the lower end of the scale of aggression in his life situation, can be raised only by having a number of battles carefully arranged for him in which he is easily the conqueror. The mouse or rat who is always defeated in battles with his fellows is less aggressive and physically weaker. He becomes smaller than others in his group, probably because he gets only left-overs to eat, and not enough of them. His capacity for aggressive behavior atrophies in the face of continual frustration.

Wide Range of Interests

All this leads to the conclusion that it is well for human beings to maintain as wide a range of interests as possible throughout life. It is well, too, to entertain and react to a broad range of stimuli in order to avoid atrophy of capacity for the reception of stimuli. Brain cells, though present, may not function to maximum capacity because they are deprived of nutrients, either lacking in the diet or not delivered to the cells because of poor circulation. Through general medical care and proper nutrition, however, brain damage in the catabolic period can be reduced to the minimum.

We can also reduce functional atrophy of the personality to a minimum. Atrophy of this sort comes rapidly in infancy and early childhood when range of function is expanding explosively. There is probably a long period of dormancy before the death of functional ca-

Dr. Lemkau is adjunct professor of public health administration, division of mental hygiene, School of Hygiene and Public Health of the Johns Hopkins University.

pacity in the mature personality. Lillian Martin and others have demonstrated that capacities which seemed lost in older individuals were not lost but only covered by the dust of disuse (*4*). Like Navy ships laid up between emergencies, coverings can be pulled off and functions made ready for action when the stress of the times is great enough.

These two basic concepts of mental hygiene for the aging—one relating to organic and one to functional changes—are not, of course, independent. One of the great problems in obtaining proper nutrition for elderly people, for instance, is getting the individual interested in his diet. He must be stimulated to eat enough of the nutrients which keep his brain working at maximum efficiency. Only then will he have the ability to react to stimuli presented.

It is always necessary to look at the factors in an older person's life which affect his ability to receive stimuli. Moreover, it is always a problem to assess how much of the loss of ability is due to organic, how much to functional, how much to mixed factors. In many instances, diagnosis is possible only during therapy. In some cases it is never possible to separate factors into those based on cell damage and those caused by inability to function because of habitual disuse.

What Is Mental Hygiene for the Aging?

To avoid loss of ability to receive stimuli, the individual must maintain his physical health at its maximum. Equally important, he must try to delay narrowing the range of his interests and activities through the constructive and creative use of leisure time.

Bringing physical status to its maximum level and maintaining it there is no simple task. It may be necessary to use psychological procedures to achieve this maximum, but these procedures are then a means to an end, and not basic mental hygiene. The field of hearing defects provides frequent examples of the neglect of the physical side of rehabilitative procedures. Surprisingly enough, many forget that the first principle of mental hygiene for the hard of hearing is the maximal restoration of hearing through treatment or through the use of artificial aids. Until the maximum possible physical ability to react to stimuli is reached, psychological procedures must take second place.

The capacities of a person to receive stimuli from the world about him decrease as he becomes older. Sight, hearing, muscle sense, tactile sensibility, and pain sensitivity all diminish progressively with increasing age. This may make it easier for the older person to allow functions to slip into disuse. The stimuli received from a symphony orchestra, for example, may be so slight that it is easy to skip concerts. Or it may be so difficult to hear a union leader as he conducts a meeting that it is easier to stop going to meetings. The emotional stimulation of discussion is lost and social contacts restricted. The life of the older person settles into a narrower path.

Change of Interests

Thus, aging is accompanied by a change of interests. The general pattern of this change is away from variability or activity and in the direction of rigidity and decreasing physical movement. Small groups are preferred to large, talking is more congenial than more active entertainment. There is a tendency, shown by psychological testing, for reactions to take longer to reach completion. All these things are probably of little consequence when they affect a person with a large store of experiences available to furnish what Adolf Meyer called "resting points of satisfaction" (*5*). But for those whose total range of experience has been small, whose life energies have been poured into few channels, they may mean almost complete extinction of interests and activity.

This is particularly true for the man who is suddenly forced to retire because of ill health or company rules. A professor may find retirement a period for accomplishing things he has often wished he had time to do. On the other hand, the executive interested only in winning as much as possible at the game of business and in losing as little as possible at golf may find his life empty when he retires and can no longer take strenuous exercise. The moving picture, "The Steps of Age" (*6*), dramatizes the vacuum resulting from the retire-

ment of a skilled workman. Rare is the man who can look forward to the respectable position of "elder statesman." Most of us must find satisfactions of our own making; we must be secure enough in our own enjoyments so that we can get along on a somewhat reduced status in the community.

"Retirement" for the woman who is the mother of a family is generally not so sudden and shocking as for the man. It comes earlier for her than for him; it is never so complete. The departure of children from the home is rarely as final or sudden as the separation of the man from his work when he retires. Household duties and responsibilities diminish gradually and rarely completely disappear. Work hours in the home are more flexible than in industry, and time can be taken out during the day for social, religious, and other types of group activity. Grandchildren extend the period of adaptability and flexibility of personality for many aging women, while their husbands are denied this salutary influence. One wonders whether this may have something to do with the greater longevity of the female in our culture.

A basic task of the mental hygiene of aging, then, is to make life after retirement an opportunity for the maintenance of a broad range of interests. The idea of prophylaxis against damaging social and emotional crises is not a new one in preventive medicine. It is fundamentally no different from universal vaccination to prepare a population to withstand a possible typhoid epidemic. Medicine needs to be equipped with health education techniques to deal with this sort of problem as well as with more familiar ones. The use of leisure time so that it satisfies us when our only time is leisure is one of these concepts.

Our problem now is how to help older people "with nothing to do that means anything." We must try to see that their lives are made more satisfying, that emotional deprivation does not lead them to behavior disorders intolerable to society. This is a job that must be done, unfortunately, in a short time. It should have been done throughout the lives of the personalities involved. The fertilized ovum is the beginning point in general mental hygiene thinking; the aged personality is a slate on which many, many words have been written, many formative experiences inscribed. The task is all the more difficult because of the progressive loss of ability to receive outside stimuli.

Socioeconomic Problems

Many problems of great concern to the mental hygienist in helping older people are socioeconomic and can rarely be controlled. The older person must pay for housing and food. Even when he can afford these essentials of living, he rarely has much cash left with which to cultivate new interests or even to continue old ones. In cultures in which the parents remain the heads of families as long as they live, their status is likely to grow with age. Consequently, their livelihood is the natural result of their ownership of the means of support for all the family. In our culture, however, children are urged to stand on their own feet, to become independent in their own right, and to be emancipated from the paternal hand. Furthermore, our modern industrial economy does not give the child the opportunity to work with his parents and establish a common economic goal with them.

So the concern of children for their parents' support is likely to be lost, and parents must rely on their own resources when they are no longer able to work. Very few are able to save enough during working years to provide independence in old age. In an inflated economy, present social security allowances, when substituted for wages, can result only in radical lowering of standards of living for many people. This lower standard may mean less satisfactory housing and insufficient amounts and variety of food.

More and more frequently, elderly people in our culture have difficulty living in the homes of their children. Once the child has broken away from the home, he seems no longer able to offer sufficient status to the parent as a member of his household to make life run smoothly. Old struggles are reactivated, the gap between the generations becomes too large to be bridged by understanding and acceptance. Permanent, comfortable, cooperative existence under the

same roof cannot be expected. Many elderly persons recognize this and resolve to live alone. Some succeed, but others are forced by inadequate finances or by concepts of parental and filial duty to live uncomfortably and under stress with their children. The high cost of modern housing, which means small houses and apartments, has markedly aggravated this situation.

These problems have been attacked in two different ways. Subsidized housing exclusively for elderly people has been built or adapted to their needs. The result has allegedly been good, not only because of the housing itself, but also because this housing usually is combined with programs for recreation and other socialization. In some places, daytime programs have been set up to provide recreational and social opportunities without any attempt at changes in housing.

The elderly person is likely to be lonely, particularly if he is widowed or not in his own house, in control of his own life. The aging process has made movement difficult and slow. It is hard to travel to see old friends, particularly if they have been scattered by changes which destroy old, familiar neighborhoods. When friends have died, too often the gap they leave in the lives of their contemporaries can never be filled because no one else is available to fill the niche. This means further emptiness and loneliness for many old people, a reduction of stimuli and, thus eventually, lessened function.

Group Activity

The gathering together of older people in communities so that they can keep the roster of friendship full and stimulating has become a recognized social service and mental hygiene measure in recent years. It has been done as a special program in connection with city community centers. Frequently, and apparently without too much difficulty, it has been combined with other types of emotional and intellectual stimulation. Older people gather together for dances, parties, games, conversation, sometimes even courtship. They show willingness to join classes and learn new skills that will give them creative outlets for hours which might otherwise be empty. The young man may be driven by ambition to educate himself, but the elderly person grasps the opportunity best under the heightened stimulation of group activity.

This type of mental hygiene activity is of relatively recent origin and, in many places, is not yet well developed. It needs to be greatly expanded. Group activities for elderly persons can be performed under the auspices of mental hygiene or church societies. The leader in charge should remember that older, more than younger folks, need a feeling of status, of control over their own destiny. He should act as a catalyst, or helper, leaving direction of the group to its own members, not to planners "doing something" for the elderly. And when it is impossible to bring groups of older people together, it may be feasible to bring outsiders to them in their homes. Some philanthropic societies have set up continuing programs for finding isolated older people and bringing stimuli to them through regular visits. These stimuli include various types of handiwork which, when completed, satisfy the need of the older person to produce something which will justify his existence.

Such programs present many problems. There is the social background of the people in the activity group. Judy O'Grady and the Colonel's Lady may be sisters under the skin, but they won't want to do the same things in a recreation group, and the direction of their creativity will be different. Some attempt at initial selection should be made, but there should also be provision made for the older person to select the type of group with which he can feel most comfortable. And there is the problem of transportation unless the programs are combined with special housing. For these reasons, neighborhood groups are probably desirable.

Goals

The opportunity to work for pay, if a man is willing and capable of doing so, would greatly reduce the mental hygiene problems of the aged and is a goal worth working toward. But even if this goal is achieved for some, there will be

many older people left to profit from learning to use and enjoy leisure time through the activities outlined above. Such activities bring happiness and relief to the elderly. They are also a means of preventing, or greatly delaying, the appearance of symptoms of mental disease and thus of sparing society the high cost of hospitalization. However, there are no conclusive data available to evaluate this point. Admissions to psychiatric hospitals are a good index provided that the availability of beds is equal in the areas compared (which is not usually the case). The fact that 31.5 percent of admissions, for instance, to New York State psychiatric hospitals in 1947 were recruited from the group aged 65 and over (*7*) indicates the tremendous practical importance of finding and evaluating ways of postponing or making unnecessary hospitalization for mental illness. Proof that programs such as those discussed here actually accomplish this would be a great stimulus to their expansion. These data should be less difficult to obtain on older than on younger groups since the number of variables to be controlled is reduced among older people.

There are many compelling reasons for carrying out mental hygiene programs with the aged. Certainly one of these is the probable prevention of the social and financial load of psychoses of old age. Another is the fact that a goal for youth is a satisfying old age. If this goal could be assured, many of the pressures and insecurities of younger people would be relieved. The giving of health, the helping to lead an aging person to a more abundant life—one with satisfaction instead of loneliness, with joy in creation instead of frustration, with pleasure in social contacts rather than irritation in meeting people—these are the most important aims of the mental hygiene of aging.

REFERENCES

(*1*) Gesell, A.: Embryology of behavior. New York., Harper and Bros., 1945, pp. 144–159.

(*2*) Bowlby, J.: Maternal health and child care. Geneva, World Health Organization, 1951.

(*3*) Allee, W. C.: Social dominance and subordination among vertebrates. Biol. Symposia. 8: 139–162 (1942).

(*4*) Martin, L. J., and DeGruchy, C.: Salvaging old age. New York, The Macmillan Co., 1930.

(*5*) Unpublished teaching material. The Henry Phipps Psychiatric Clinic, The Johns Hopkins University Medical School.

(*6*) Mental Health Film Board: The steps of age. Distributed by the International Film Bureau, Chicago, Ill., 1950.

(*7*) The Council of State Governments: The mental health programs of the forty-eight States. Chicago, 1950, p. 215, footnote 7.

PHS films

You Can Be Safe From X-Rays

16 mm., sound, black and white, 10 minutes, 1952.

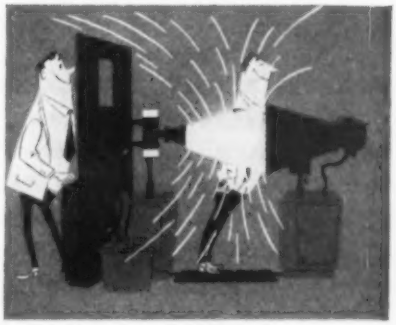
Audience: **Personnel concerned with operating X-ray equipment.**

Available:

***Loan*—Medical Directors, (PHS) Federal Security Agency Regional Offices. Also from Communicable Disease Center, PHS, P. O. Box 185, Chamblee, Ga.**

***Purchase*—United World Films, Inc., 1445 Park Avenue, New York 29, N. Y.**

This filmograph was prepared by the Division of Chronic Disease and Tuberculosis of the Public Health Service, as a training aid for X-ray technicians and other personnel. It stresses the hazards of secondary radiation in X-ray installations and outlines protective measures against overexposure to radiation. In cartoon style, it depicts an X-ray technician who takes excellent care of his equipment but does not use the same care in protecting himself from the harmful effects of too much X-ray exposure. The effects of excess radiation are discussed, the hazards outlined, and protective measures described in detail. The point is emphasized that X-ray can be safe when those who handle it know the facts and follow simple safety rules.



Sanitary Landfills in Northern States

— *A Report on the Mandan, North Dakota, Project* —

By RALPH J. VAN DERWERKER, B.S.

Of 135 North Dakota municipalities surveyed in 1947–48, only three used incinerators for refuse disposal, and three others relied on the open-face dump type of sanitary landfill. The open dump was the only answer to the problem in 129 communities.

Seeking a sanitary solution to the refuse disposal problem, the North Dakota State Department of Health invited the Public Health Service to participate in a study of the use of landfill techniques for small cities and towns in cold climates. The city of Mandan, which has a population of 7,298 (1950 census) and where winter temperatures of −30° to −35° F. are not uncommon, was selected for an experimental landfill project. In the spring of 1949 the project got under way.

By agreement, the city paid for an equipment operator and other costs, in addition to providing the site. The State was responsible for office and travel expenses. The Public Health Service obtained the necessary heavy equipment and assigned a sanitary engineer to take charge of the project.

When the official participation of the Public Health Service ended with completion of the first year of operation, sufficient data had been accumulated to show that the sanitary landfill satisfactorily and economically could solve the problem of refuse disposal for northern communities. However, at the beginning of the second year, another Public Health Service sanitary engineer was assigned to the project to continue gathering data for another year.

Site Selection

The choice of landfill sites narrowed down to two: One included some 20 acres of land located a little over 1 mile from the main street; the other was an open-face dump operated by the city on low, submarginal land which filling would make usable. The latter, however, was close to the center of town, and because of the experimental nature of the project the city commissioners favored the out-of-town site. The Public Health Service engineer approved of the out-of-town site because it was particularly well-suited for the trench-type of landfill and thus would have more demonstration value for other communities.

The selected site was elevated considerably above the surrounding terrain, well exposed to the high winds prevailing in the area. It had a 2.5 percent slope at the southern end, rising gradually to 6 percent at the north. There was a shallow ravine in the east-central portion,

---

Mr. Van Derwerker is the chief of the municipal and rural branch of the division of sanitation, Bureau of State Services, Public Health Service. *This paper, a review of the operation of the Mandan project, is based on progress reports made by the project engineers, Leo Weaver and Donald M. Keagy, division of sanitation, Public Health Service. A detailed technical report of the experiment is being prepared for publication.*

---

and a deep coulee on the northeastern end. Excellent drainage existed. Soil analysis showed 64.2 percent sand, 13.5 percent silt, and 22.3 percent clay.

It was decided to construct the fill in the form of a wide **U** so that refuse could always be dumped with, instead of into, the wind. A topographical map facilitated accurate planning with respect to grades, size of fill site, and other work. The fill when completed would be a uniformly sloping field with excellent drainage.

Operation

The first trench was excavated in June 1949. The original trench width of 1½ times the width of the tractor was increased later to 2½ times (or about 17 feet) to permit more maneuverability for backing the collection truck into the trench in order to protect the refuse from high winds. Experience shows that too wide a trench, however, reduces efficient operation, since too much cover material is required each evening.

The usually recommended trench depth for a sanitary landfill is about 3 feet for a one-level fill. The average depth at Mandan, however, was 6 feet in order to provide extra protection from the high winds and additional dirt for a two-level fill. The extra depth encouraged careful dumping by individuals, after hours, since they seem to prefer to throw refuse into an excavation rather than on the surface.

The two-level operation proceeded as follows: First, the refuse was placed in the trench and compacted to 5 or 6 feet (fig. 1). Then, it was covered with 9 to 12 inches of dirt. When enough area on the first level had been built up to permit free operation of the tractor and dumping vehicles, the second level was started (fig. 2). This type of operation made it possible to use the lower level when strong winds were blowing, and the upper level during periods of calm. Cover material for the upper layer was obtained by excavating the next trench to be used at the lower level.

Figure 1. Construction of first level of fill.

Figure 2. Construction of second level of fill.

Experimentation with various depths of cover material indicated that 2 feet of cover under average conditions will result in not less than 1 foot at all points, which is sufficient for sanitary purposes. Approximately 5,518 cubic yards of earth were dug and used for cover during the first year of operation. This gives a volume rate of 4.7 acre feet per 10,000 population, as against a generally accepted rate of 6 acre feet per 10,000. The reasons for the lower rate at Mandan were, probably, that the quantity of domestic ashes was small, due to the extensive use of natural gas, and that Mandan does not produce the large amounts of solid, industrial wastes common to many other towns.

It was essential to guard against mixing too much dirt with the refuse. Otherwise, the available cover material is too rapidly depleted, and the trench becomes deeper than is desirable.

Controls Necessary

Operations were impaired at first by the absence of regulations establishing daily hours for dumping. The fill was left each evening in neat and orderly condition, and the records

show that no fires ever started in completed cells. However, material dumped indiscriminately during nights and week ends caused fires and created public health and nuisance hazards, which made it necessary to establish and enforce strict dumping hours.

The city collected refuse from the residential areas on a fee basis, but business establishments either hauled their own or contracted with private haulers. Some difficulty was encountered in trying to get the latter to dump at specified points. This was overcome gradually through the encouragement of community support by means of an active public relations program, principally by means of articles in the local newspapers. The operator-foreman was very helpful, also, in patiently explaining the operation to all visitors.

Paper and Fire

Windblown paper constituted a serious nuisance, even though the problem had been anticipated. The erection of a windrow, the two-level design, the depth of trenches, and the U-shape of the fill, all had been planned to counteract the effect of high winds. In addition, a 4-foot chicken-wire fence was erected, but it was not particularly effective in overcoming the problem. Subsequently, the problem was solved by the use of snow fences.

The paper collected from the residential areas was well mixed with garbage, and was not much affected by the wind, but refuse from the business district was mostly paper and created a greater problem.

Fires seldom, if ever, occur in properly compacted and covered refuse, but they may occur in material deposited during the day or when the operator is off duty. Hot ashes may smoulder unnoticed, and suddenly burst into flame; refuse compacted in a truck may blaze suddenly when dumped and exposed to air. Daytime fires can be extinguished quickly by covering and compacting. Trucks carrying smouldering material were also unloaded at the unused end of the trench, or in another trench.

Vermin

Daily compaction and covering of the refuse seemed to eliminate any fly-breeding or rat-breeding problem. Flies, however, followed each truck during hot weather and were drawn to bits of garbage adhering to the tractor, necessitating the spraying of the tractor with DDT in order to protect the operator. On larger projects, it may be necessary to make scheduled use of insecticides on the truck bodies and over the site.

Preparation for Winter

Original plans called for the preparation of a trench 300 feet long, 6 feet deep, and 22 feet wide, to be prepared and placed in reserve for winter operations. However, because of the limited data available on volume of refuse, it was later decided to dig a second reserve trench, which measured 100 feet in length, 25 feet in width, and 6 feet in depth.

The second reserve trench actually had to be put in use early in March 1950. The continuance of winter operations was insured by this foresightedness. Refuse delivered to the fill in February averaged 69 yards per working day, or a total of 1,656 yards. Experience showed that a reduction of 65 to 75 percent could be obtained through compaction.

To provide cover material for the time when it would be too cold to dig, about 700 cubic yards of dirt from trenches dug in the fall was stockpiled as close to the working area as possible. The practical distance for a stockpile seems to be up to 100 feet from a trench. Probably a limit of 50 feet should be set when a crawler tractor is used.

The stockpiles were built with their axes parallel to the prevailing northwest winds to keep them comparatively free of snow, and their sides were sloped steeply to shed rain. With a moisture content at excavation time of 9.2 percent, and of 4.9 percent when sampled from the stockpile in January, lumping never became a serious problem when moving earth from the pile for cover.

Winter Operation

Over 72 inches of snow fell up to April 1—more than ever before recorded; and more fell during April. On recommendation of the State highway department, however, snow

Figure 3. Old dump area prior to landfill operations.

Figure 4. Dump site after landfill operations.

fences had been built at the landfill site. Drifting, therefore, caused no difficulties, and snow did not accumulate in large quantities in the trenches.

The temperature in January 1950 averaged −10.2° F.—a new record for the month—with a minimum recorded temperature of −44° F. The entire winter was severe, as indicated by the fact that the Missouri River ice break-up did not occur until April 15, later than ever before. But equipment problems were surprisingly few. The daily starting of the diesel-driven tractor was made possible through the building of a garage at the site, in which an oil stove, burning continuously, kept the temperature at a constant 20° to 30° F. A well-constructed, heated cab in the tractor is essential. Also, the tractor was equipped with grousers for use on ice or hard-packed snow.

Other Experiences

Experience at places other than Mandan indicate that winter landfill operations may be facilitated by one of the following procedures:

1. Plow or scarify the area to be excavated before the frost arrives and place insulating material (leaves, hay, etc.) to a depth of at least 3 feet, replacing the insulating material over the working area as the trench is excavated.

2. Excavate the required number of trenches in advance, and stockpile the cover material. Work the stockpile, if wet, to insure drying, and protect it with leaves, placed in the form of cells, with each cell being opened as cover material is needed. Leaves should also be mixed into the pile.

When spring floods cut off the approach road to the trench landfill site, in March 1950, operations were moved to the vicinity of the former open-face dump, where an area type of landfill was started (figs. 3 and 4). The speed and ease with which the move was made indicate the versatility of the landfill method of disposal.

In the new area, water from the spring runoff stood 3 feet deep, making it impossible to obtain cover material by trenching. Cover material was obtained from various places—from the upper layers of the old dump, from a nearby hill, etc.

The depth of the new fill was from 12 to 15 feet. Therefore, refuse was deposited in two layers, for the same reasons which dictated this type of operation at the original site.

The rat population at this dump, of course, had been eliminated when dumping was discontinued. Otherwise, the rats would have migrated to new food sources, with consequences which could have been tragic to the residents of the community. Under supervision of the United States Fish and Wildlife Service, poisoning operations were carried out by employees of the city street department.

Cell Temperatures

High temperatures in a closed cell result from anaerobic bacterial activity and digestion of organic material. The degree of heat and its duration are excellent measures of the bacterial action. The following temperature data are presented from the experiment conducted at Mandan.

Temperature graphs were maintained on three test cells, identified as C_1, C_2, and C_3, from

January 1950 through June 1951. The first two cells were located on the original landfill site, and the last on the new site at the former city dump. These graphs were combined with a graph of the daily atmospheric temperatures to show the relationship between air temperature and temperatures in the cells (fig. 5).

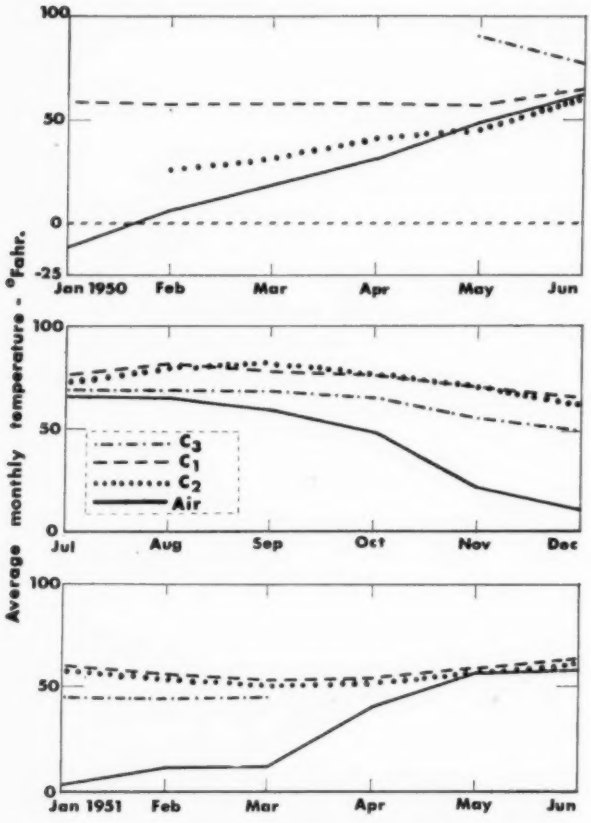


Figure 5. Comparison of monthly averages of cell and atmospheric temperatures, Mandan landfill project.

Refuse was deposited in cell C_1 in November 1949 and the cell was closed, but temperature-recording equipment was not available until January 1950. From then through May 1950, the graph shows that a stable temperature was held, apparently independent of atmospheric conditions, including the winter period.

Cell C_2 was completed in January 1950. The conclusion reached from the temperature graph for this cell is that refuse placed, compacted, and covered in freezing weather generates little or no heat from decomposition until atmospheric temperature rises high enough to permit bacterial activity.

Cell C_3 was started and completed in warm weather. The internal temperature of the cell rose to a peak of 93° and fell to 83° F. within a single 2-week period. The rise to only 93° F. indicates a high content of inorganic material in the refuse.

The temperature data also show that the temperature peaks in the three cells were considerably lower than the 140° to 180° F. frequently mentioned in literature on similar studies. Probably the reason for the slow decomposition of the refuse was the high paper and cardboard content which did not provide optimum environment for bacteria. It may be necessary, in similar operations, to provide a catalyst in order to promote complete bacterial reaction within a reasonable time.

The equipment used for temperature-recording was not expensive, and should be within the reach of any community. It was comprised, basically, of a maximum-registering thermometer, which is familiar to all milk sanitarians, and a prepared 6-foot length of pipe. The thermometer mentioned cannot be used when atmospheric temperature is greater than cell temperature. For a complete year-long record, a dial-type thermometer is needed.

Refuse Analysis

The laboratories at the Environmental Health Center, Public Health Service, in Cincinnati, Ohio, performed monthly chemical analyses of raw-refuse samples from Mandan through the year 1950, with the exception of November. They also made analyses in July 1950 and July 1951 of samples of refuse which had been buried in July 1949.

Probably the most significant indication of bacterial action already accomplished and remaining to be accomplished was the BOD (biological oxygen demand) results. The BOD dropped from an average of 77,050 ppm for the fresh garbage and refuse, to 30,000 ppm for that buried for 1 year, to 23,500 ppm for that buried for 2 years. These figures appear to follow an asymptotic curve, as would be expected. However, it appears that even after 2 years of burial, a considerable amount of bacteriological decomposition remains to be accomplished under the climatic conditions of the North.

Settlement and Soil Analysis

Data compiled concerning the percentage and time of settlement showed that (1) the minimum percentage of settlement over a 24-month period was zero, (2) the maximum over a 17-month period was 18 percent, (3) the lowest percentage of settlement occurred in the first cells, which were constructed during the summer, and (4) the highest percentage occurred in the cells constructed during the winter.

The rate of settlement, however, is affected by many variable factors: the skill of the operator in placing, compacting, and covering the refuse; the percentage of garbage in the refuse; the percentage of dirt mixed with the refuse; the amount of travel over completed cells by tractors and trucks; the depth of individual cells; and weather conditions at the time refuse is deposited. The last factor includes the probability that the operator will do a less thorough job of compacting at 20° below zero than at 60° above, and the fact that frozen refuse is less compactable. Therefore, it is difficult to predict accurately the percentage of settlement that a sanitary landfill in a cold climate will show.

Adequate standards which will enable an engineer to submit a soil sample from a proposed landfill to a soil laboratory and receive sound information on all the problems he may encounter remain to be developed.

In the meantime, H. W. R. Larson, of the Bureau of Reclamation Soils Laboratory, Bismarck, N. Dak., has suggested that all soils be submitted for mechanical analysis. In the case of heavy soils, Dr. Larson recommends determination of the sulfate ion as a test for gypsum content, and determination of the lime content as a test of porosity. These would indicate how easily the soil could be handled. Also, for heavy soils, Dr. Larson states that determination of exchangeable sodium will tell whether or not the soil will work in lumps.

Weight and Volume

Weighing of the Mandan refuse was begun in February 1950 and continued through May. Of course, for reasonably accurate weight and volume data, a full year's figures are desirable. However, two interesting facts were uncovered from the 4-month experience: (1) an average weight of 3 pounds of refuse per capita per day; and (2) an almost equal division between refuse from the business district and that from the residential areas.

For purposes of comparison of one community's experience with that of another, weight records are much more reliable than volume estimates. The Mandan experience indicates the unreliability of cubic yardage figures. Loads on the 12-yard packer truck varied from 60 to 80 percent of capacity, depending on the truck's mechanical condition. Therefore, an assumption that 50 loads totaled 600 yards could be up to 40 percent erroneous. Also, yardage from a nonpacker truck obviously cannot be considered the same as that from a packer truck.

Costs

The average monthly cost of operating the sanitary landfill at Mandan, based on a 10-month study, was $432.98. This figure includes the pay of the equipment operator ($235.91 for an 8-hour day and a 6-day week); $27.73 for fuel, grease, repairs, and other operating costs; $22.34 for general expenses, such as fencing, land, etc.; and $147.00 for tractor amortization ($8,000 at 4 percent over a 5-year period).

The average amount of refuse deposited monthly (February through May 1950) was 327.55 tons. Applying this 4-month weight average to the 10-month cost average shows a disposal cost of $1.32 per ton. This means an increase in the monthly disposal cost of $282.98, or of 86 cents per ton, since Mandan had previously paid a dump attendant $150 a month.

The 10-month period included 255 working days, during which the tractor and operator worked a total of 536 hours, or 2.1 hours per working day. Assuming that they were used on other municipal projects for only one-half of the possible working time, a reasonable cost estimate for the operation of the landfill could be worked out as follows:

Wages (4-hour day, 6-day week)	$117.50
Operating costs	30.00
General expenses	25.00
Amortization	73.00

On the basis of 327.55 tons of refuse per month, this computation brings the cost per ton to 75 cents.

Repair costs over a 5-year period will, as a rule, be larger than those shown in the Mandan experience, but they may be offset somewhat by salvaging used equipment, by careful operation and maintenance of equipment, and by judicious use of municipal repair facilities and labor.

Note that these estimates include amortization of equipment, which few communities consider in their cost tables. Eliminating the amortization figure reduces the cost per ton to 53 cents, which is comparable to the unit cost commonly reported for a sanitary landfill.

In final analysis, actual landfill costs will depend on what a community charges to operation, and on planning and efficiency.

Conclusions

The primary purpose of the Mandan experimental sanitary landfill project was to determine if this method of refuse disposal would be practical in the colder portions of the United States. The winter operation in Mandan has answered this question affirmatively.

With proper planning and efficient operation, a community of 5,000 population should be able to manage a sanitary landfill. On a project of this size, the tractor is required for only 2 or 3 hours a day, and is available the rest of the day for gravel loading, snow removal, street excavation, or other municipal requirements. Such an arangement, of course, would make it essential to regulate dumping hours at the fill strictly, to prevent the scattering of refuse during evenings and week ends.

Communities smaller than 5,000 population might modify the landfill method with a form of sanitary trenching. In this, of course, it would be necessary to clean up the site before digging the trench. Usually, the accumulation on small dumps can be moved only by heavy equipment; thus, the trench may have to be dug by county or rented equipment. In this form of operation, the refuse should be compacted and covered at least twice weekly in warm weather, and as often as practicable in the winter.

A small road scraper or bulldozer can be used if heavy equipment cannot be obtained. Large items, such as tree limbs, car fenders, barrels, etc., would have to be removed by hand.

The steps in the operation of a sanitary trenching area by a small community can be itemized as follows:

1. Clean up the old dump and exterminate rats.
2. Build an all-weather road to the site.
3. Dig a trench, storing dirt at the ends or on the sides.
4. Designate a specific area for large objects.
5. Work over the refuse in the trench, and cover the top and face with at least 2 feet of dirt.
6. Each spring, incorporate the large objects into the fill, burn the accumulated brush, and dig a new trench.

Sanitary trenching is not as good a method of disposal as a sanitary landfill, but it is a vast improvement over the usual open dump.

Coming in Public Health Reports

Next month's issue will include the first of a number of reports and papers on world health developments: *international health assistance programs* described in maps, text, and pictures, with "case reports" of current projects . . . a *symposium* from the 3d National Conference of the U. S. National Commission for UNESCO, with contributions by Gaylord W. Anderson, Joseph W. Mountin, Albert W. Dent, and Frank G. Boudreau, and an introduction by C.-E. A. Winslow . . . *The WHO and Environmental Health*, by Herbert Bosch . . . and a review of the work of *WHO Expert Committees* written by American members.

Tests of 2,4-Diaminopyrimidines On Toxoplasmosis

By DON E. EYLES, Sc.D. and NELL COLEMAN, A.B.

Tests of several compounds of the 2,4-diaminopyrimidine group have shown two members of the group, particularly 2,4-diamino-5-(4′-chlorophenyl)-6-ethyl pyrimidine (DCEP), to be active against toxoplasmosis.

DCEP is an effective antimalarial drug, as shown by Falco and associates (*1*), with a proguanil equivalent of 40 against *Plasmodium gallinaceum* and 200 against *Plasmodium berghei*.

To test their antitoxoplasmic activity, DCEP and related pyrimidines were screened by our laboratory for their effect against *Toxoplasma gondii* in the mouse. We are reporting the results of these screening tests and more extensive tests with DCEP.

Methods

Young mice (weight about 20 gm.) of the NIH general purpose strain and a strain of *T. gondii* isolated by this laboratory from the Norway rat were used in the tests. With an intraperitoneal inoculum of 20,000 organisms, prepared by diluting peritoneal exudate with physiological saline, mice invariably died, usually in 7 ± 1 days. Six mice so infected were used in the screening of each new drug. Untreated controls and clean controls were kept for each group of tests.

Drugs were administered in pulverized diet starting just after inoculation and continuing for 14 days. Dosages are stated as milligrams percent in diet and were at the maximum tolerated dose (MTD) if it was known. Conversion to milligrams per kilogram was made by using an average daily food intake figure of 4 gm. Drug activity was measured by the degree of prolongation of life of treated mice over the controls. Significance was measured by comparing the mean duration of life of the untreated and treated groups by means of the T-test (*6*).

The more extensive tests with DCEP required the determination of the dose-effect relationship against similarly induced infections. Nine or more mice per dosage level were used. The Litchfield and Wilcoxon (*4*) method of calculating the median effective dose (MED) was utilized. Since cure was infrequent, the MED was defined as the dose which permitted half the mice to survive 10 days or longer. Ten days was the period used because the test showed greater sensitivity at that time than at 14 days, thus facilitating comparison with less active drugs and with drugs of limited supply, which necessitated a shorter treatment regimen.

Results

The results of the screening tests are given in table 1; results of one test with sulfadiazine

Dr. Eyles and Miss Coleman are from the laboratory of tropical diseases of the Microbiological Institute, National Institutes of Health, Public Health Service, and are stationed at Memphis, Tenn.

Table 1. Summary of screening tests with 2,4-diaminopyrimidines

Drug	Dosage (mg. percent in diet)	Mean days to death (controls)	Mean days to death (experiment)	Delay of death due to drug [1]	Proguanil equivalent [2] *P. berghei*
5-(4′-chlorophenyl)-6-ethyl (DCEP)	8	7.3	10.8	+3.5(S)	200
	12	7.3	10.5	+3.2(S)	----------
5-(4′-chlorophenyl)-6-*n*-amyl	100	6.8	9.6	+2.8(S)	8
5-(4′-chlorophenoxy)-6-methyl	250	6.8	7.4	+.6	.7
5-(4′-nitrobenzyl)-6-methyl	50	6.8	6.8	0	1.5
Sulfadiazine	500	7.3	12.2	+4.9(S)	----------

[1] In calculating this mean all animals still living on the 14th day are considered as having lived just this long; letter (S) indicates significant difference between test and control.
[2] From Falco and associates (*1*).

are included for comparison. DCEP and 2,4-diamino-5-(4′-chlorophenyl)-6-n-amyl pyrimidine were significantly active. DCEP was considered sufficiently effective to warrant further investigation, since several animals not only lived longer than the controls, but also survived indefinitely.

The dose-effect curve for DCEP is shown in the chart. The MED was calculated as 9 mg. percent in the diet (95-percent confidence limits, 15 and 5). This is the equivalent of about 18 mg./kg. per day (calculated on the basis of 4 gm. of food consumed per day). According to data in this laboratory, sulfadiazine has, in comparison, a MED of 40 mg. percent in the diet. Gram for gram, DCEP is more effective, but its therapeutic efficiency is much lower, as 9 mg. percent is close to the MTD, which was found to be 32 mg. percent; whereas, the MTD of sulfadiazine is at least 12 to 24 times the MED.

DCEP appeared to cure some mice; a number of animals survived until killed or challenged 42 days after the day of infection. Table 2 presents these data and data on survival until the end of the 14-day treatment period. The number of mice which survived for 14 days was only slightly smaller than the number surviving for 10 days. Of the 23 mice which survived 14 days, 9 were still living at 42 days. With one exception, all of the mice which died between the fourteenth and the forty-second day died within a week of the end of the treatment period. This was somewhat different from groups given sulfadiazine; post-treatment deaths in these mice occurred frequently two or more weeks after the end of treatment (*5*).

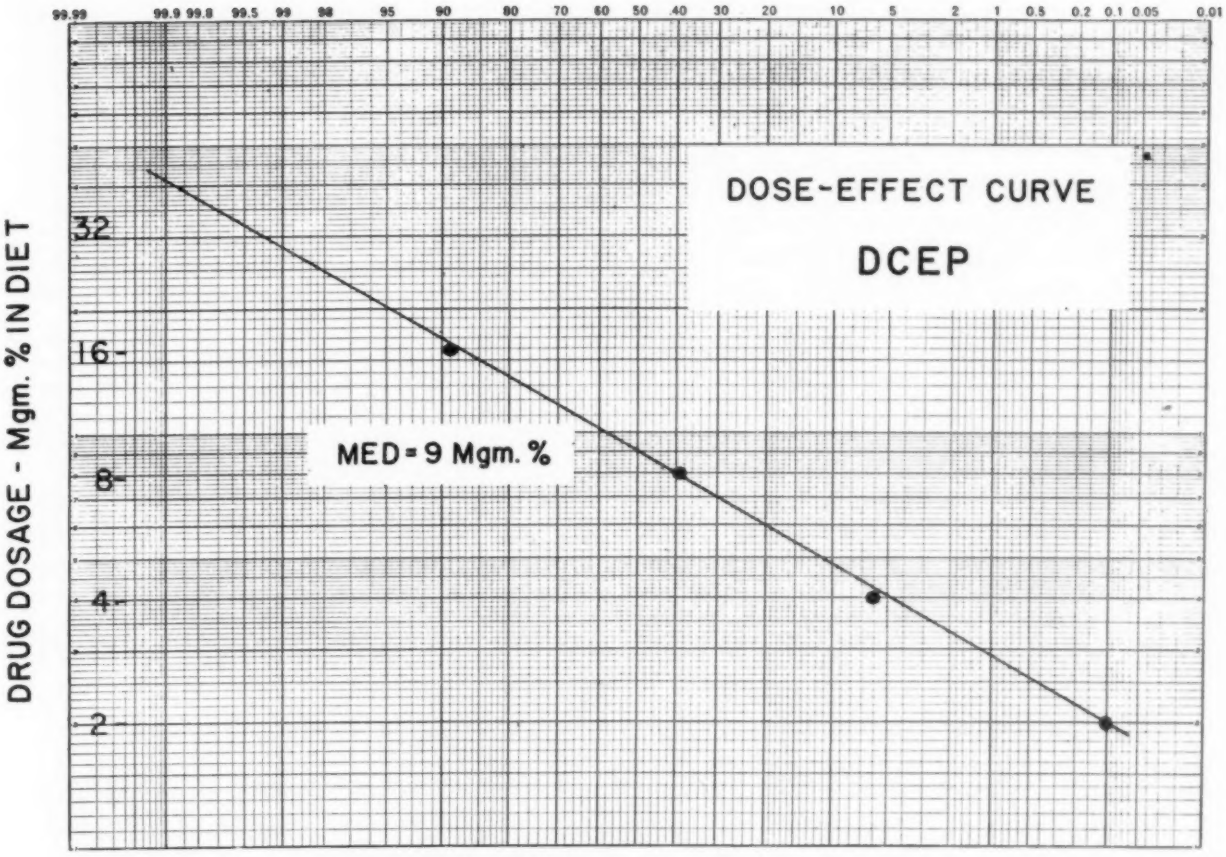
In order to determine if the mice surviving 42 days were cured (free of organisms), four of the nine mice were killed, and suspensions of brain and liver tissue from each were inoculated intraperitoneally (i. p.) into two clean mice. One of the mice inoculated from one survivor died from toxoplasmosis in 6 days; none of the other mice developed the disease during a 42-day observation period.

To determine if surviving animals were immune to reinfection, five of the survivors were challenged with an i. p. inoculation of 20,000 *Toxoplasma* organisms on the forty-second day. Four of the mice died in the usual 7 ± 1 days, but one survived until the tenth day. The last finding may possibly have significance in indicating some degree of immunity.

None of the animals killed on the forty-second day showed any organisms in smears made from brain, liver, spleen, peritoneal fluid, and lung.

Table 2. Survival and possible cure after treatment with DCEP

Dosage (mg. percent in diet)	Number of animals	Survived 10 days	Survived 14 days (end of treatment)	Survived 42 days (cured?)
32 (toxic)	9	4	3	2
16	15	10	9	4
12	6	2	2	2
8	24	11	8	1
4	18	1	1	0
2	9	0	0	0
1	9	0	0	0



Dose-effect curve for 2,4-diamino 5-(4'-chlorophenyl)-6-ethyl pyrimidine.

Discussion and Conclusions

These findings add another chemical group to those known to be active against toxoplasmosis. They also illustrate an instance of parallelism between antimalarial and antitoxoplasmic activity. Experiments are now in progress to determine if sulfadiazine and 2,4-diaminopyrimidines act synergistically as in malaria therapy (*2*) and if pteroylglutamic acid (PGA) antagonizes their effect (*3*).

The investigation so far indicates, but does not prove conclusively, that DCEP is a curative drug in some instances. More animals must be subjected to subinoculation tests, and other animals must be observed for longer periods of time. Further tests must be made using large inoculums. In any event, the efficiency (ratio MTD/MED) of DCEP alone is so low (about 3 or less) that it is not likely to be a practical drug in human toxoplasmosis although the different host may affect its action. If DCEP proves to act synergistically with sulfadiazine then it may be of practical importance in enhancing the effect of that drug. If it is antagonized by PGA, interesting hypotheses with regard to the physiology of *Toxoplasma* may be raised.

Summary

Screening of compounds for antitoxoplasmic activity showed two members of the 2,4-diaminopyrimidine group to have effect. The most active compound was 2,4-diamino-5-(4'-chlorophenyl)-6-ethyl pyrimidine. Defining the effective dose as the dose permitting 10-day survival, this compound had a MED of 9 mg. percent in the diet as compared with 40 mg. percent for sulfadiazine under identical conditions.

The efficiency of the drug was low, as the MTD/MED ratio was about 3 or less. The cure rate following 14-day treatment was also low since only 9 of 33 mice (27 percent) given doses higher than the MED survived for 42 days.

* * * * *

Since preparing this paper, it has come to the attention of the authors that Dr. W. A. Summers of the Indiana University Medical Center has tested some of the compounds reported in this paper with results parallel to those reported here. Dr. Summer's work will be separately published.

ACKNOWLEDGMENT

The drugs used in these experiments were obtained through the courtesy of Wellcome Research Laboratories, Tuckahoe, N. Y. The desirability of screening these compounds was pointed out to the authors by Dr. G. Robert Coatney. Acknowledgment is due also to Jean Vaughan and Ernest Guy for technical assistance in obtaining data for this report.

REFERENCES

(1) Falco, E. A., Goodwin, L. G., Hitchings, G. H., Rollo, I. M., and Russell, P. B.: 2:4-Diaminopyrimidines—A new series of antimalarials. Brit. J. Pharmacol. 6: 185–200 (1951).

(2) Greenberg, J., and Richeson, E. M.: Potentiation of the antimalarial activity of sulfadiazine by 2,4-diamino-5-aryloxypyrimidines. J. Pharmacol. & Exper. Therap. 99: 444–449 (1950).

(3) Hitchings, G. H., Elion, G. B., VanderWerff, H., and Falco, E. A.: Pyrimidine derivatives as antagonists of pteroylglutamic acid. J. Biol. Chem. 174: 765–766 (1948).

(4) Litchfield, J. T., Jr., and Wilcoxon, F.: A simplified method of evaluating dose-effect experiments. J. Pharmacol. & Exper. Therap. 95: 99–113 (1946).

(5) Sabin, A. B., and Warren, J.: Therapeutic effectiveness of certain sulfonamides on infection by an intracellular protozoon (*Toxoplasma*). Proc. Soc. Exper. Biol. & Med. 51: 19–23 (1942).

(6) Snedecor, G. W.: Statistical methods. Ed. 4. Ames, Iowa, The Iowa State College Press, 1946.

International Tuberculosis Control Program

In a 4-year international tuberculosis campaign involving 22 countries on five continents, the United Nations International Children's Emergency Fund (UNICEF) and three Scandinavian relief agencies tested 37 million children and young adults and vaccinated nearly 17 million with BCG.

The Scandinavian associates—the Danish Red Cross, Norwegian Relief for Europe, and the Swedish Red Cross—started the work of tuberculosis control projects after World War II and were joined by the UNICEF in 1948. They have now withdrawn from the program after fulfilling their commitments.

Czechoslovakia, Poland, Hungary, and East Germany participated in the European phase of the program. Poland was highest in numbers of vaccinations with 2,535,026. Czechoslovakia was second, and East and West Germany, considered together, were third.

The UNICEF is continuing the international campaign and plans to test the entire child populations of Asia, Latin-America, and the Eastern Mediterranean countries. Five million children already have been tested in Ceylon, India, and Pakistan. The World Health Organization is responsible for the technical aspects of the program.

The results of the campaign will not be fully known until the children and young adults vaccinated have reached maturity. However, already there are some favorable indications in Poland, where very few of the persons vaccinated have contracted tuberculosis.

Staining Treponema Pallidum And Other Treponemata

By B. S. LEVINE, Ph.D.

The principles of staining necessary to obtain suitable results in the direct microscopic count of milk have been outlined in a previous publication (*1*). That study was originally undertaken to improve milk-film staining procedures. However, the principles discussed apply equally to other types of biological staining, and study has been made of the staining of spirochetes, especially those of the *pallidum* type.

A comprehensive review of the literature pertaining to the staining of *Treponema pallidum* was presented by Campbell and Rosahn (*2*), and recently DeLamater and others (*3*) have described a new modification of the Fontana staining procedure. Campbell and Rosahn classify all previously recommended procedures for staining *T. pallidum* into two groups. In the first group, the spirochetes are impregnated by a dye or a metallic ion and made visible against a pale background. In the procedures of the second group, the background is darkened by a material such as India ink or by an alteration in the method of illumination, as in the dark-field procedure. The value of the dark-field method of examination in the hands of an experienced person can hardly be overestimated as a rapid and reliable diagnostic aid. However, efforts to develop a quick and easy staining procedure for the demonstration of spirochetes, and especially of *T. pallidum*, have never abated.

Concerning the impregnation of spirochetes by dyes and metallic ions, the statements made by Campbell and Rosahn can well be repeated. These authors state: "At one time or another practically all the dyes utilized by the histologist have been employed in efforts to stain the spirochete. In all cases simple aniline dyes alone have not succeeded in staining the organism sharply, and only when a suitable mordant was employed was the stain at all reliable." Most staining procedures based on the mordanting principles are complex, time consuming, inconsistent in the hands of the same technician, and frequently result in complete failure in the hands of well-trained laboratory workers. Silver impregnation techniques, while apparently highly specific for spirochetes, are not adaptable to routine laboratory work. They appear to be best suited for tissues. In addition, as aptly stated by Campbell and Rosahn, "Silver impregnation techniques when applied to smears have for the most part resulted in atypical forms with marked changes in the regularity and shape of the spirals . . . ."

Dr. Levine is a bacteriologist with the research and development branch of the Public Health Service Environmental Health Center in Cincinnati. *This paper was presented at the general session of the meeting of the Society of American Bacteriologists on May 31, 1951, at Chicago, Ill.*

The Staining Procedure

Survey of the literature cited, personal interviews with research workers in this field, and visits to several venereal disease research labor-

atories and syphilis diagnostic clinics indicated the need for the development of a spirochetal staining procedure which could be used routinely in clinical and public health laboratories. Based upon experience with many spirochetal staining formulas and the principles of biologics staining cited (*1*), a number of procedures for the preparation of spirochetal slide specimens and a number of staining solutions considered appropriate were prepared. Staining tests made led to the development of the following staining procedure.

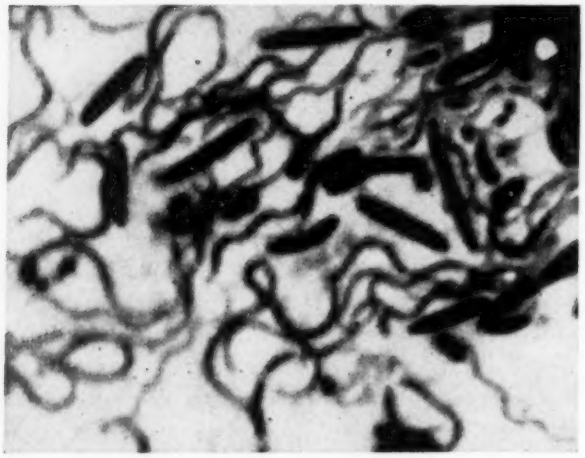


Figure 1. Trench mouth smear (×3,300).

Preparation of Smears or Films

The materials tested were: (1) culture suspensions of the following avirulent spirochetes—(*a*) Reiter's, (*b*) Nichols, and (*c*) the Kazan strain; (2) oral smears from persons known to harbor a variety of spirochetes; (3) suspensions of testicular material of rabbits experimentally infected with Nichols strain of *T. pallidum;* (4) suspension of testicular material of a rabbit experimentally infected with a strain of *Treponema cuniculi;* and (5) smears from clinical cases having genital lesions which were positive by dark-field examination. In all cases the material was spread thinly over an area approximately 1 cm. square, and dried in the air. The slides were then placed in a removable slide tray or a Coplin jar and defatted for 2 minutes or longer with U.S.P. chloroform, made acid-free with an excess of sodium or potassium carbonate. The slides were then drained and dried free from chloroform. They were again submerged for 2 minutes or longer into another glass container filled with 95-percent ethanol or methanol likewise made acid-free by adding an excess of sodium or potassium carbonate. The slides were again drained and dried free of the alcohol.

Preparation of Stock and Final Stain Solutions

Staining of any of the previously mentioned spirochete-containing materials can be accomplished either with crystal violet or with basic fuchsin. The use of certified dyes is recommended. Prepare: (1) a 2.5-percent solution of sodium or potassium carbonate in distilled water and (2) a 1-percent solution of crystal violet or of basic fuchsin in distilled water. These should be labeled "Stock Solutions." They can be kept indefinitely without serious deterioration.

For the preparation of the final staining solution, place 89 ml. of distilled water in a clean glass beaker. Add to this 1 ml. of either the potassium or sodium carbonate stock solution. Mix well. To this add rapidly 10 ml. of either crystal violet or basic fuchsin stock dye solution. Mix well. The final stain-solution should not be prepared until the slides are ready for staining. Staining should be done as soon as possible after the final stain-solution has been prepared. It is recommended that after 4 to 6 hours a new final stain-solution be made. The addition to this final staining solution of sodium bicarbonate in varying amounts tends to stabilize it, so that it can be used for a longer

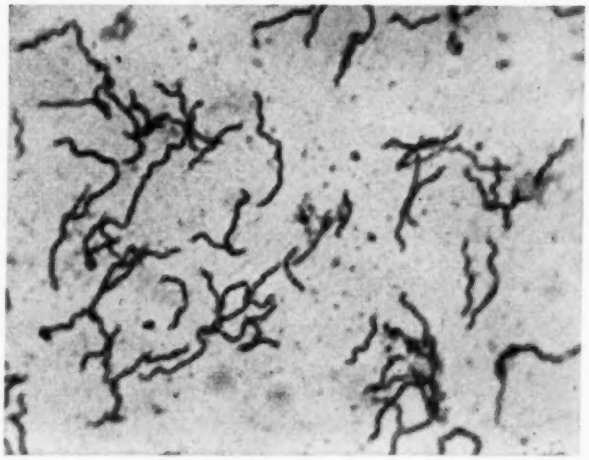


Figure 2. Culture of avirulent Reiter's spirochete (×1,500).

period of time. Such stabilization of the final staining solution as indicated thus far appears to add nothing to the spirochete-staining properties of the solution.

Staining of Slide Specimens

Place the previously prepared slide specimens in a Coplin jar or removable slide tray and MacCallum type of staining dish. Fill the staining dish with the final crystal violet or basic fuchsin stain-solution until slides are completely submerged. Two minutes is a sufficient time interval for proper staining. Leaving the slide specimens in the final stain-solution for a longer period will not cause overstaining. It is, however, considered best to adhere to the 2-minute staining interval. Remove the slides from the staining solution one at a time or, if a tray is used, remove the entire lot and rinse lightly in a beaker or other suitable glass dish containing tap water until it is judged that excess stain has been removed. Drain, air dry, and examine microscopically.

It was observed on numerous occasions that the presence of phosphates in the preparation material appears to interfere with the proper staining of the finer forms of the spirochetes. It is therefore suggested that extraction of testicular material be made with distilled water or with isotonic saline.

Under the microscope, treponemata, especially *T. pallidum*, stained with basic fuchsin appear to be very slender and to have a smooth and even surface. Crystal violet imparts to the spirochetes a greater thickness and a certain coarseness of surface. With either stain, however, the morphology of the spirochetes remains unaffected. For this reason it is rather easy, after some experience, to differentiate *T. pallidum* as it occurs in rabbit testicular or clinical material from the avirulent types as presented by the cultures previously mentioned. Differentiation is not so simple with oral smears, for in these, on occasion, spirochetes which only a few microscopists can differentiate with any degree of certainty are observed. Clinical syphilologists say that in the case of suspicious genital lesions the proper decision can be arrived at with ease, as it is generally believed that spirochetes other than *T. pallidum* do not invade the deeper tissues.

Precautions

Attention is invited to the following consideration: The standing procedure described takes into account certain principles of adsorption. Each step outlined is designed to meet certain specific conditions of such adsorption. It is therefore recommended that the procedure be adhered to as closely as possible. It is especially recommended that the prepared slide specimen be submerged into the final dye solution edgewise, as previously described. Placing the slide specimen horizontally on a staining table and flooding it with the final dye solution is definitely not recommended.

Advantages of the New Staining Procedure

The advantages of the staining procedure described are as follows: No mordants are required; no heating of the specimens or of any of the solutions is necessary; the reagents used are commonly found in any public health or clinical laboratory; staining can be accomplished within 5 to 10 minutes; a trayful of slide specimens takes no longer to stain than a single specimen; the tolerance range with regard to the prevailing pH of any of the solutions is rather wide, thus eliminating the need for unusual care in the staining process; the slides can be destained and restained any number of times (as will be described later) without in any way affecting the original staining properties or the morphology of the spirochetes. Permanent mounts can be made or the specimens can be destained and restained if fading has occurred, or, if it is desired, the same slide may be studied as stained first with the crystal violet and then with the basic fuchsin, or conversely. Other advantages of this staining procedure may make themselves evident to the laboratory worker as he gains experience with it. What has been specifically mentioned is sufficient to indicate that the staining procedure described appears adaptable to routine laboratory procedure.

To destain and restain a specimen, treat the slide as if it had not been stained. First, defat in the acid-free chloroform; this will remove the immersion oil and will almost completely destain the specimen. Second, submerge the

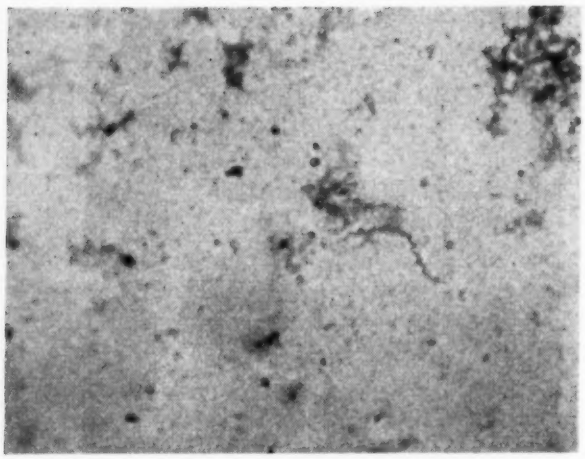


Figure 3. From experimental rabbit syphilis; Nichols virulent strain (×1,500).

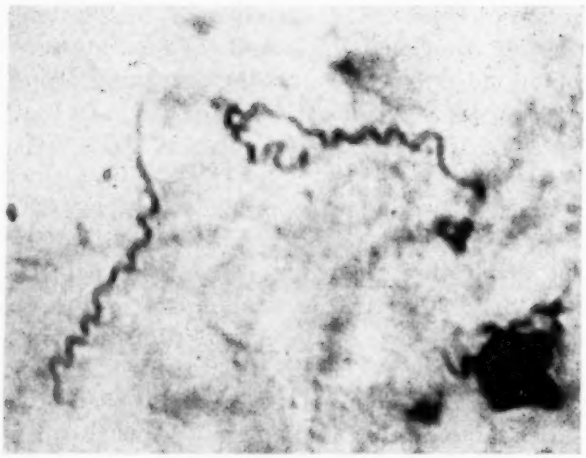


Figure 4. From primary penile lesion Alto Medical Center, Alto, Ga. (×3,300).

slide in acid-free ethanol or methanol. This will complete the destaining of the slide. Restain as described. For classroom demonstration or exercise, and where securing of new slide specimens presents difficulties, a set of slides once used can be destained and presented to new students as if the slides had not been previously used. It is, of course, necessary to take care that the material forming the film is not destroyed by scratching it off in part or in toto through careless handling.

Because of the simplicity of this spirochetal staining procedure and the reproducibility of results even upon destaining and restaining, it can be used in determining the rate of spirochetal growth in cultures by standardizing microscopic count procedures similar to the direct microscopic count of milk (*4*). Slides thus prepared can be filed for record purposes or for simultaneous comparative studies. In experimental rabbit syphilis, testicular material can be aspirated at certain intervals, and studies made microscopically of the degree of spirochetal proliferation, of the maturity of the treponemata, of the presence of involutional or otherwise unusual forms, as well as of the presence of possible contaminants.

Use in Epidemiological Studies

It has been suggested by some public health syphilologists that the staining procedure here described might find practical and useful application in the field of syphilis epidemiology. For example, it has been known for some time that a patient with a genital lesion of a suspicious type usually reports to the nearest general practitioner for examination. Such practitioners, as a rule, are not equipped to make dark-field examinations in order to ascertain the true nature of the lesion. As a matter of public health safety the assumption is usually made that the lesion is a specific one, and the patient is made noninfectious by an adequate administration of penicillin. The patient is then directed to report to a public health clinic. However, by the time the examining physician in the public health clinic sees such patients the primary infective agents causing the chancre have been eliminated by the penicillin. The proper epidemiological study of such cases thereby has been complicated or rendered impossible.

Using the spirochetal staining procedure described, situations such as have been mentioned can be handled as follows: (1) Physicians can be instructed to make slide smears of suspected lesions of their patients prior to administration of the penicillin; (2) the slides, properly labeled for identification, can then be sent to the public health laboratory for staining and microscopic examination; and (3) the epidemiological records can thereby be made complete.

Summary

Staining procedures offered heretofore for the examination of materials suspected of har-

boring virulent and avirulent spirochetes have been briefly reviewed and evaluated. A new, simple staining procedure for similar purposes is described. It appears suitable for routine laboratory use, in classroom work, and in research studies. However, no attempt should be made to employ this staining procedure in the place of the dark-field examination or any other established diagnostic procedure until sufficient evidence accumulated on a broad basis indicates that this staining procedure is dependable.

ACKNOWLEDGMENTS

The author acknowledges the cooperation given him by authorities of the Venereal Disease Research Laboratory, the officer in charge of the Alto Medical Center, Alto, Ga., and the photographic section of the Communicable Disease Center, all of the Public Health Service; and of Dr. J. H. Stokes, Dr. Harry E. Morton, and Noel Rose, of the Institute for the Study of Venereal Diseases of the University of Pennsylvania.

REFERENCES

(*1*) Levine, B. S.: Improving staining procedures in the direct miscroscopic examination of milk. J. Milk & Food Tech. **13**: 321–329 (1950).

(*2*) Campbell, R. E., Rosahn, P. D.: The morphology and staining characteristics of *Treponema pallidum*. Review of the literature and description of a new technique for staining the organism in tisues. Yale J. Biol. & Med., **22**: 527–543 (1950).

(*3*) DeLamater, E. D., Hannes, M., and Wiggall, R. H.: Studies on the life cycle of spirochetes. II. The development of a new stain. Am. J. Syph., Gonor. & Ven. Dis., **34**: 515–518 (1950).

(*4*) American Public Health Association: Standard methods for the examination of dairy products: Microbiological, bioassay and chemical. New York, 1948, pp. 107–117.

Extension Service in Parasitology

A new extension service program in parasitology is being developed by the laboratory branch of the Communicable Disease Center, Public Health Service, Atlanta, Ga. The program will be available only to students who have completed the CDC parasitology courses in the laboratory diagnosis of intestinal or blood parasites, beginning with the 1951 fall group of graduates. For a specified time following completion of the laboratory course, the students will receive specimens for examination and identification.

This program replaces the service which was in operation by the CDC parasitology laboratory from 1945 to January 1, 1951. This service was terminated partly because the list of recipients had grown beyond the facilities for collection and preparation of materials for this purpose.

Students who completed the parasitology courses earlier than the fall of 1951 may request parasitology loan sets at any time.

An extension service program covering all specialties is being contemplated for the State public health laboratories. Details of the program will be submitted to the State health laboratory directors in the near future for their consideration and comment.

Preamble to the Constitution

of the

WORLD HEALTH ORGANIZATION

The States parties to this Constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest cooperation of individuals and States.

The achievement of any State in the promotion and protection of health is of value to all.

Unequal development in different countries in the promotion of health and control of disease, especially communicable disease, is a common danger.

Healthy development of the child is of basic importance; the ability to live harmoniously in a changing total environment is essential to such development.

The extension to all peoples of the benefits of medical, psychological and related knowledge is essential to the fullest attainment of health.

Informed opinion and active cooperation on the part of the public are of the utmost importance in the improvement of the health of the people.

Governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures.

Accepting these principles, and for the purpose of cooperation among themselves and with others to promote and protect the health of all peoples, the Contracting Parties agree to the present Constitution and hereby establish the World Health Organization as a specialized agency within the terms of Article 57 of the Charter of the United Nations.

World Health Day

April 7, 1952

Healthful Surroundings Make Healthy People—the theme of World Health Day in 1952—points to a goal shared by all nations, and it shows where some of the problems lie which must be solved if efforts to improve health throughout the world are to succeed.

Despite the magnificent progress made by medical science, three out of every four men, women, and children in the world still suffer from diseases spread by unsafe water supplies, unsanitary excreta disposal, uncontrolled insects and rodents, and inadequate protection of milk and other foods. The responsibility for this tragic wastage of human life and energy rests with each of us, individually, in our threefold capacity as members of the family and of the local community and as citizens of a shrunken world.

Each of us needs to realize that sanitation is, after all, a way of life. Whether we live in a "developed" or an "underdeveloped" country, it is our duty both to ourselves and to our neighbors to practice certain elementary principles of hygiene which can be applied with little, if any, expense by individuals and families. By keeping a clean home, a clean shop, a clean factory, and a clean neighborhood, we are meeting one of the first requirements for our own health and for a healthy community.

But we must go beyond this; we must also support fully the establishment and develop-

ment of local and national programs in community sanitation. They deserve our support because they aim at providing services designed to protect us against the many dangers that may threaten health and life if conditions in our physical environment are unsatisfactory.

Finally, as citizens of a world where all men have become neighbors, we must share with one another the things we learn about promoting health and preventing disease through the techniques available to the modern science of environmental sanitation. Such an exchange of knowledge among all countries is justified on humanitarian grounds as it is essential for reasons of self-interest. The World Health Organization has, from its beginning, given a high priority to international measures for raising standards of environmental sanitation. Along with its other activities, WHO will continue to support and encourage local, national, and international efforts directed towards helping people to achieve a reasonable control of the physical features of their environment.

I earnestly hope that the observance of World Health Day on April 7 will serve to make clear to men, women, and children everywhere the value of healthful surroundings and their importance for the health of all peoples.

Brock Chisholm, M.D.,
Director-General,
World Health Organization

World Health Day

in the

UNITED STATES

World Health Day again gives the people of the United States an opportunity to salute the World Health Organization and its great objective, "the attainment by all peoples of the highest possible level of health." Today we will join with our friends throughout the world in rededicating ourselves to the cause of health at home and abroad.

The World Health Organization can look back with pride at its achievements during the past year. Death rates are declining wherever work has begun in earnest. Malaria, one of the most serious handicaps to cultural and economic development, is receding before the onslaught of organized action. Technical assistance programs have brought benefits to countries most in need.

The theme of World Health Day for 1952 is "Healthful Surroundings Make Healthy People." In this way, the World Health Organization calls special attention to the importance of environmental sanitation.

Since its inception, the World Health Organization has promoted the improvement of all aspects of environmental hygiene. Through its programs, it has emphasized sanitary living and working conditions as a basic requirement for human health.

The Secretariat of the World Health Organization, its Expert Committees, and its Regional Offices have enhanced respect for human life and helped to make the world a safer abode for man. We in the United States are happy to participate in these efforts which bring within reach an ideal dear to all Americans.

Leonard A. Scheele, M.D.,
Surgeon General, Public Health Service,
President, Fourth World Health Assembly

National Program for Interstate Milk Shipments

By LEONARD A. SCHEELE, M.D., and HARRY G. HANSON, B.S., M.S.E.

As a background for the views of the Public Health Service on a national program for interstate milk shipments, we would like first to describe briefly the responsibilities of our organization in the broad field of milk sanitation. Then we shall outline for you the major problems, as we see them, which necessitate the establishment of a cooperative program for the certification of interstate shippers of milk.

The Public Health Service has a long-standing and dual interest in milk and milk products. These products occupy a unique position in human nutrition and they play an important role in the transmission of infectious diseases to man.

The nutritional importance of milk and milk products is one of the foundation stones upon which the dairy industry has been built. Adequate amounts of milk and milk products are not only essential to the maintenance of good health in all age groups, but in these days of high costs of living, these products are still among the best buys in terms of food value per dollar of expenditure. Thus, the Public Health Service, along with other health agencies, has long advocated—and continues to advocate—the increased consumption of milk and milk products.

Dr. Scheele is Surgeon General and Mr. Hanson is Executive Officer of the Public Health Service, Federal Security Agency.

This statement was read by Mr. Hanson in a symposium before the Fifth Annual Meeting of the Dairy Products Improvement Institute, Inc., in New York, January 17, 1952. At the same time, "The Purpose, Plans, and Progress of the National Conference on Interstate Milk Shipments" were discussed by J. L. Rowland, M.P.H., chairman of the conference and director of the bureau of food and drugs of the Division of Health of Missouri; and C. J. Babcock of the Production and Marketing Administration of the Department of Agriculture spoke on "Standards for Grades of Milk and Cream for Manufacturing Purposes."

Early PHS Investigations

To make possible the increasing consumption of milk in our growing urban population, the Public Health Service has also been concerned with the safety of market milk. The interstate quarantine responsibilities of the Service as early as 1893 directed our attention to the role of milk in the transmission of infectious diseases. Early bacteriological investigations made by the Service led to the establishment in 1923 of an Office of Milk Investigations, which had the responsibility of investigating milk-borne outbreaks of disease, recommending methods for their prevention and control, and establishing standards for the sanitary quality of milk and milk products served aboard trains and ships operating in interstate commerce.

These investigations, as well as more recent studies, were conducted in cooperation with the dairy industry and State and local health agencies. One result of these scientific studies was the conclusion that a safe milk supply for the public required the elimination of disease in dairy herds, the application of sanitation techniques to milk production, and the effective pasteurization of milk and milk products.

The first World War gave significant impetus to improved sanitation in this country. At that time, we experienced our first crisis in public

health with respect to increased mobility of population and concentration of military personnel in areas lacking modern methods of sanitation and milk control. A review of milk control regulations then in force revealed that many States and municipalities had no such regulations. Among those that had adopted milk control laws and regulations, there was a lack of uniformity in approach and standards which negated the possibility of a safe and acceptable milk supply for the Nation as a whole.

Cooperative Development of Standards

These findings clearly indicated the need for practical and uniform regulations, based upon sanitary science and veterinary medicine, which could be adopted and enforced throughout the Nation. The Public Health Service therefore drew together a group of authorities in the field—whose institutional connections included State and local health agencies, the dairy industry, universities, and State departments of agriculture—to assist in the development of a municipal ordinance for milk sanitation. In 1932 a National Milk Sanitation Advisory Board was appointed and the Public Health Service has maintained such an advisory body to the present day, with the addition of experts in other fields of food sanitation.

With the advice of its consultants and with the active cooperation of the States, cities, and the dairy industry, the Public Health Service developed in 1923 a standard ordinance for voluntary adoption. Since that time, there have been nine revisions of the Milk Ordinance and Code Recommended by the United States Public Health Service, including that of 1952, which will be published in a few months.

Each revision of the recommended ordinance and code has been accomplished with the active cooperation of our advisory board and representatives of the groups who aided in the original development. We emphasize the Public Health Service's method of cooperative action because there is a tendency nowadays to assume that any action by any Federal agency is designed to bring about Federal control and regulation. The long-established policy and practice of the Public Health Service has been to bring about the solution of broad problems affecting the Nation's health preferably by the collection of scientific data, consultation, technical aid, and cooperation, rather than by undertaking the enforcement of regulations ourselves.

We would like to add that this has been our policy and practice even when Congressional legislation has given us clear regulatory and enforcement authority—as in the case of the control of biological products and of interstate quarantine. Up to the present time we have found this approach both economical and effective. The public, as well as the Federal Government, the industries involved, and the State agencies, have been spared the costs and delay of regulatory hearings and court action. And in each instance, there has been protection for the public and unabated progress in the development, distribution, and sale of safe and potent biological products and in the sanitary quality of foods and water served on interstate carriers.

Sanitary Control of Market Milk

The Milk Ordinance and Code Recommended by the Public Health Service was prepared for voluntary adoption by local governments. What has been the effect of this proposal upon the sanitary quality of market milk consumed in the United States?

At the present time, the ordinance and code has been adopted by more than 1,500 municipalities and 387 counties in 38 States and Alaska. It is also the basis of milk sanitation laws or regulations in 34 States, Alaska, and Hawaii. Eleven of these States and the two Territories enforce the code state-wide. Included in this milk sanitation program are 55 cities with populations of over 100,000, and 38 with populations of 50,000 to 100,000. According to data from the 1950 United States Census, more than 60,000,000 persons are thus protected by the milk ordinance and code which was first developed jointly by the dairy and related industries and Federal, State, and local health agencies nearly 30 years ago.

In 1938, milk-borne outbreaks constituted one-fourth of all disease outbreaks due to infected foods and polluted water. The most recent data show that milk and milk products are

responsible for only 3½ percent of such reported outbreaks. Today, more than 90 percent of the market milk consumed in the United States is pasteurized—a phenomenal development over the past 30 years.

Public health agencies do not claim that the long-term cooperative program in milk sanitation has been the sole factor in the improvement of the Nation's milk supply. But there is good evidence that this joint effort of the health agencies and the industries has been and is a major and decisive factor. The reduction in the incidence of milk-borne diseases and in the mortality from these causes over the past 30 years has been an outstanding accomplishment. Many groups have contributed to this achievement. Public health and agricultural agencies, the dairy and related industries, the medical and veterinary professions, educational institutions, and an enlightened public all share the credit.

Constant Supervision Needed

Despite the progress that has been made, we must continue our efforts to protect our market milk supplies and milk products. Constant vigilance is as essential in this area as in the maintenance of safe water supplies. The fact which we must keep ever in the front of our thinking, our planning, and our operations is that milk is an efficient medium for the growth of pathological organisms. A safe milk supply demands effective sanitation techniques at every stage of production, processing, and delivery.

This is not to say that effective sanitation today is identical in every respect with that of 30 years ago. The results of scientific research and technology have made available new types of equipment and less burdensome methods. The Public Health Service, the related industries, and many State and local agencies have recognized and stimulated technological progress in this field. The numerous revisions of the ordinance and code testify to this determination on our part and that of our advisers to keep pace with new developments and thus to give the public the benefits of scientific progress.

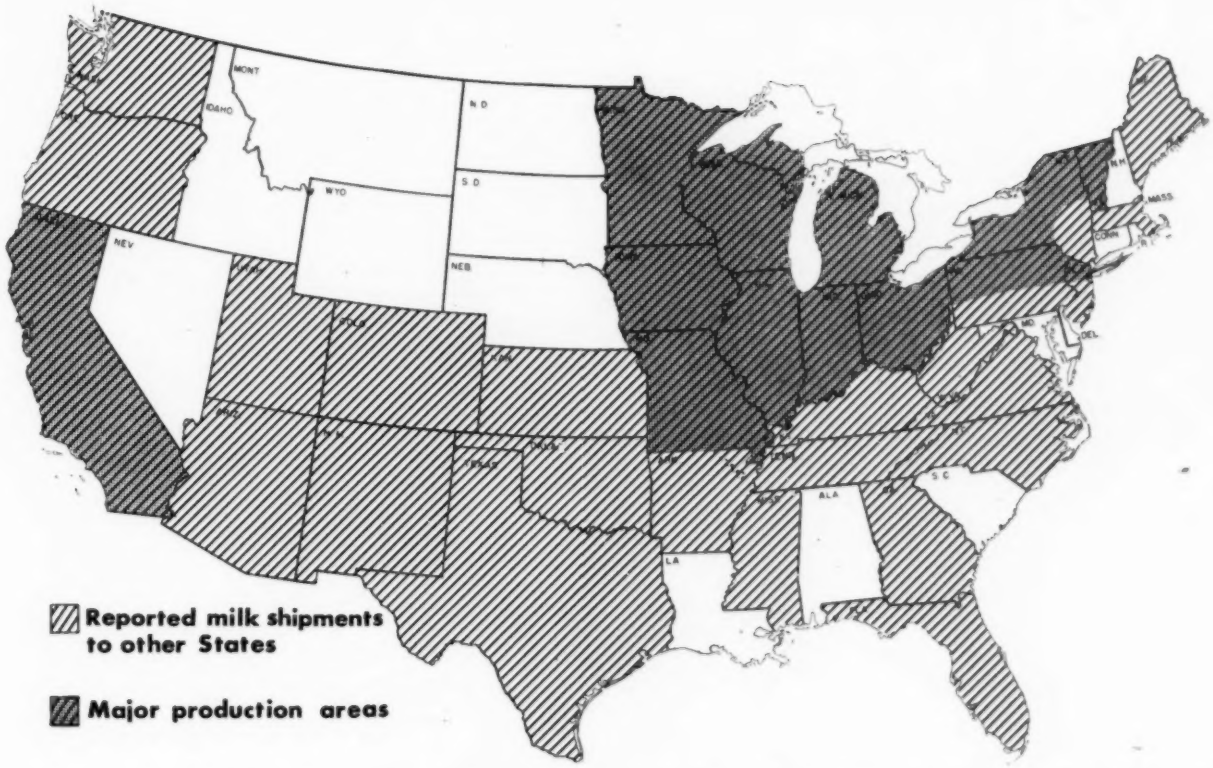
It is true that not all of the old problems in milk sanitation have been solved. Indeed, new ones are constantly coming to light. The control of brucellosis is still a major problem. The recent demonstration that Q fever organisms exist in some dairy herds requires that intensive research be directed to the mode of transmission of this disease to man. New methods for processing, packaging, and marketing milk and milk products are constantly being introduced. If these methods are to be widely adopted, both consumers and producers need the assurance of careful scientific studies upon which to base the needed safeguards.

Use of Chemicals and Antibiotics

There is a wide gap between our precise knowledge and the safe use of chemicals as preservatives, or of antibiotics in the treatment of dairy herds, or of insecticides in the eradication of disease-carrying flies, mosquitoes, and so on. In these situations, medical and related research has a big job to do to determine the cumulative effects of small amounts of such substances in milk as consumed by the public.

We should like to point out, however, that all of the agencies and industries involved are faced with a dilemma. Failure to use the necessary amounts of antibiotics and insecticides would certainly expose the public to serious risks of infection with the dysenteries, streptococcal and staphylococcal infections, and other dangerous diseases which may be transmitted by the milk of infected herds or by insects. On the other hand, some health authorities have raised the question of possible toxic reactions to small amounts of DDT in milk, for example; or of resistance in children to antibiotics through the ingestion of small amounts in the milk of animals treated with such drugs.

Man's environment has always presented risks to his health and safety. The question today is whether the use of chemicals—both in the war against communicable disease and in the production and distribution of a safe, ample, varied food supply for every part of the country—presents serious risks to public health; or whether uncontrolled sources of infection or reductions in needed food supplies present more serious risks than the use of chemicals.



The Public Health Service is aware of the dilemma. Through our laboratory and field research centers, we are now developing an intensive research program directed to studies of the chemical environment as it affects human health. Many of the problems to be investigated concern the dairy industry and the official agencies, as well as the public. Our view is that scientific research can provide the answers which will make possible the application of valuable chemical techniques without significant risk and with great benefit to the public.

The Public Health Service works—and always has worked—on the principle that new techniques recommended to the public for better health or for greater health protection must be not only effective but safe. The basis of assurance is thorough, multidisciplined research in pertinent experimental, clinical, and epidemiological fields. We consider that such investigations are part of our general responsibility for the public health.

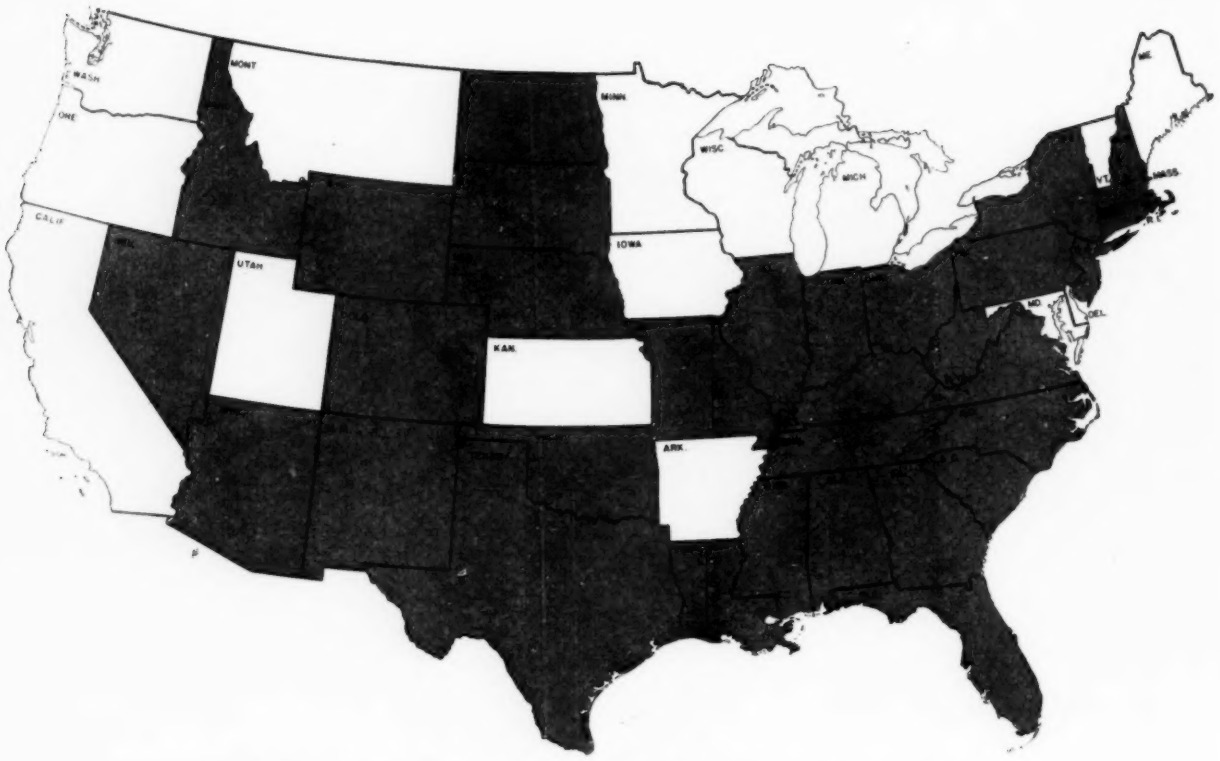
Even so, we are bound to admit that no method or agent used in medical and public health practice is completely free of risk. Exceptions to demonstrated findings of safety and effectiveness are bound to occur. Both private physicians and health agencies are obliged to take calculated risks in discharging their responsibilities to society. Their decisions must be based upon scientific determinations that the risk is minimal and that it is outweighed by demonstrated benefit to the individual patient or the public.

Interstate Milk Shipments

The technical problems in milk sanitation which we have been discussing are accompanied by another larger problem, namely, the interstate shipment of milk and milk products. A practical solution for it has been proposed.

Until comparatively recent years, the volume of market milk and cream shipped in interstate commerce was small. It created no special problems except for large metropolitan centers such as New York. The public demand for these products, however, has exceeded the local supply in many areas, and throughout the past 10 years the needs of the armed forces also have increased markedly.

Interstate milk shipments today indicate that the problem is national in scope and volume.



Shaded States report receipt of milk shipments from other States

At present—as shown by the maps—32 States, the District of Columbia, and Alaska import fluid milk and cream for public consumption, and 34 States are exporters.

Estimates from 40 States show that a minimum of 13,000,000 pounds of milk and cream are shipped interstate—daily. Shipments include both pasteurized milk and cream in bottles and cartons, and raw milk in bulk for pasteurization in importing localities.

Prior to the development of refrigerated transport, the production and marketing of milk could be considered almost exclusively a local affair. Each locality produced enough milk to meet the local demand except during brief seasonal shortages. The development of local milk sheds for each community, with local controls to insure a clean and wholesome product, was the pattern established to meet the limited demands of that period.

Under present conditions, this pattern is not adequate to meet the demand for milk and milk products in metropolitan centers and milk-deficient areas. Industrialization, increases in population, accelerated urbanization, and related factors all have contributed to the change. The importation of market milk and cream across State lines is an essential element of the Nation's economy. The public health problem involved is to afford the authorities of importing areas reasonable guarantees as to the safety and wholesomeness of imported milk and milk products.

The Multiple Inspection Problem

State and local governments have the legal right and authority to satisfy themselves that milk received from outside their jurisdiction shall be safe. Officials of importing States and municipalities have usually taken the position that imported milk should meet sanitary requirements identical with those imposed upon local producers. As a result, many milk control agencies have adopted the practice of sending their own inspectors to the States from which the shipments come.

Inspection at the source creates a great deal

of difficulty in the interstate shipment of milk. In the first place, the regulations of the shipping areas may differ widely from those of the receiving municipalities. Second, it is not uncommon for numerous municipalities to purchase milk from the same interstate shipper. As a result, multiple inspections of the same supply by sanitarians from many different jurisdictions impose an unwarranted burden upon producers. Producers resent these confusing and troublesome practices and they are interested in finding a way to eliminate them.

It is easy to see why. The dairy farmer—the dairy industry in fact—knows that the requirements essential to protect the consumer against disease are practically the same regardless of the geographic area involved. Hence, he cannot understand why the requirements of different local jurisdictions differ or contradict each other. He cannot understand why health authorities of one jurisdiction should not accept the results of inspections by health authorities of another.

The Public Health Service holds the same view as to the desirability of uniform regulations and reciprocity in the inspection of milk. We have long felt that the first step toward a successful interstate milk shipment program must be acceptance by all concerned of common criteria for the evaluation of the sanitary quality of a milk supply.

There is no question that a State or community has the right to inspect at the source the milk and milk products it is to receive. But it is our view that some less cumbersome, less expensive, and more efficient method can be developed which will meet universal approval and will benefit all interests. Multiple inspections are expensive for both shipping and receiving areas and sometimes absorb tax funds which are urgently needed for other health purposes. The maintenance of multiple standards by milk producers may also require unnecessary expenditures which increase the cost of milk to the consumer.

It is doubtful also that infrequent inspections by sanitarians from distant areas provide more than superficial protection, since such inspections are not followed by routine control measures. In this connection, the health authorities of some shipping communities do not assume responsibility for the sanitary supervision and control of surplus milk produced under their jurisdiction on the ground that it is not for local consumption.

Because of the expense involved, many importing States and municipalities cannot afford to send their own men to the State of origin. The alternatives, as the officials in the importing areas see it, have been to accept milk of unknown or questionable sanitary quality, or to refuse permission to import milk even though it is needed to provide adequate supplies for their communities. Some authorities have refused to accept any milk from beyond the limits of their own routine inspection, although during periods of extreme shortage they may permit the importation of milk not subject to any sanitary control.

Health Rules as Trade Barriers

Obviously, there are important economic as well as health factors involved in the shipment of milk from surplus to deficient areas. Without attempting to discuss the economics in detail, we do wish to emphasize that the invocation of health requirements as a means of solving problems of trade and commerce is unwarranted. This practice has been increasing in recent years, and has given rise to serious interference with interstate and even intrastate commerce. It has not afforded greater health protection and has actually made increased consumption of milk and milk products more difficult for the lower-income families in some areas.

The technique most commonly used is to insert into local milk sanitation regulations restrictive requirements that can be met only by local producers and processors. Most such restrictions have little or no public health significance, and are even difficult to guise as public health requirements.

As an example, some municipalities forbid the sale of any milk that is not pasteurized within so many miles of the center of the community. The assumption is that all milk pasteurized beyond that point is not safe to drink, since the city does not wish to inspect it. The purpose of these arbitrary requirements is, of course, to exclude all outside milk re-

gardless of its wholesomeness, thus preventing competition.

The growth of these trade barriers has been so rapid, and their effect on interstate milk shipments so great, that in 1950 the United States Supreme Court and a committee of the United States Senate both dealt with the matter.

Supreme Court Ruling

The Supreme Court, during its October 1950 term, ruled that a city could not adopt discriminating health regulations which act as trade barriers against interstate commerce. Such action, the Court stated, could not be taken, even to protect the public health and safety, providing that reasonable nondiscriminatory alternatives were available to afford such protection. The Court then pointed out that two reasonable alternatives exist. A city may rely upon its own officials for inspection of distant milk sources; or it may rely on inspections made by health authorities at the source, as provided in section 11 of the Milk Ordinance and Code Recommended by the Public Health Service. This section establishes reciprocity as a basis for acceptance of outside milk, and defines the criteria which must be met.

The Senate Committee on Agriculture and Forestry, through a subcommittee, held public hearings to determine the cause and effect of restrictive regulations and reported, August 1, 1951, that the movement of milk in interstate commerce was being impeded, and indicated that a solution must be found. The committee stated that it was not yet prepared to recommend Federal inspection, but it endorsed a second solution, namely, for the Public Health Service to increase its efforts to develop a cooperative program with the States for the certification of interstate milk shippers.

The Public Health Service concurs heartily with these recent recommendations of the Supreme Court and the Senate Committee. We hope that health agencies everywhere will resist local groups who promote the practice of adopting health regulations in order to set up trade barriers. It is also hoped that the Supreme Court decision will be a deterrent to the future incorporation of trade barriers in local milk legislation, and that such obstacles to the free movement of milk will be removed.

An Interstate Certification System

Throughout the past 10 years, State and local health authorities, agricultural officials, and the dairy industry have intensified their demands for a plan for certification of interstate milk shipments on which importing areas may rely with confidence. The Food and Drug Administration and the Department of the Army have endorsed the idea. The Association of State and Territorial Health Officers, the American Public Health Association, and the Conference of State Sanitary Engineers have formally requested the Public Health Service to develop such a plan, in cooperation with the States. These groups have expressed the opinion that, since the problem is an interstate one, some degree of coordination and assistance by the Public Health Service is required.

Since 1946, the Public Health Service has been receiving more and more requests to make inspections of interstate milk supplies. For example, in 1949, State and local milk control agencies requested the Public Health Service to inspect the supplies of more than 170 individual shippers drawing milk from more than 40,000 dairy farms. The Service, with a very limited budget for all its milk and food sanitation activities, was not in a position to honor all these requests, nor did we feel that it was our place to do so. These requests emphasize the need for a system of certification based on adequate sanitary control and inspection by the State in which the milk is produced.

Conferences on Interstate Shipments

Early in 1950, representatives of 11 Midwestern State health departments met in Chicago to determine what action could be taken to establish such a program on a nation-wide basis. Subsequently, two National Conferences on Interstate Milk Shipments were held in St. Louis. Representatives of agriculture departments and health departments from 26 States attended, as well as representatives of the dairy industry and the Public Health Service. A third conference is scheduled for June 10–12 in St. Louis.

The plan and procedures as developed by these conferences incorporate the views of the majority of the receiving and shipping States.

The elements of the program in which the participation of the Public Health Service is specifically requested may be summarized as follows:

1. Ratings of the milk sheds of interstate shippers are to be made periodically by the State of origin in accordance with the uniform milk sanitation rating procedures developed by the Public Health Service. The results of such ratings are to be reported to the Public Health Service for certification.

2. Frequent spot check surveys are to be made by Public Health Service milk specialists of the inspection, laboratory, and rating procedures of each State participating in the program. Such spot checks are necessary to protect receiving areas against laxness on the part of milk sanitation authorities in shipping areas.

3. Lists of interstate shippers, as rated by the shipping States, are to be published and widely distributed semiannually by the Public Health Service. Between publication dates, State ratings as reported to and certified by the Public Health Service are to be forwarded to receiving areas as supplements to the published list.

4. The Public Health Service is to assist the States, when requested, to develop and improve their milk control programs, standardize procedures, and train State, municipal, and industrial inspectors and laboratory personnel.

5. The Milk Ordinance and Code Recommended by the Public Health Service is to be used as the basic standard for evaluating or rating interstate milk supplies. As stated earlier, this ordinance has been incorporated in the milk sanitation regulations of 32 States and 2 Territories.

Some States have already initiated the program on a limited basis. Ratings submitted by these States have been published by the Public Health Service, and include the names and ratings of 182 shippers located in 17 States and the District of Columbia.

The agreements reached and the decisions made by the States themselves at the two National Conferences on Interstate Milk Shipments represent, in our opinion, the most progressive step taken to date toward solution of the health problems involved in interstate milk shipments. The Public Health Service endorses the national program proposed by these conferences, and, within the limits of our budget, we propose to assume the responsibilities which its full implementation would place upon us. Obviously we cannot take on all of these duties immediately without increasing our staff.

Need for Industry Participation

If it is to accomplish its purpose, the proposed national program for interstate milk shipments must have the endorsement of all regulatory agencies, and of the producers, processors, and distributors of milk and milk products. It needs the support of this Institute and the members of this audience. It needs your active, voluntary participation. We believe that such participation is to your advantage, and is certainly within the pattern of conscientious, public-spirited service which has always marked the operations of the dairy industry.

Many unforeseen problems will arise which will have to be worked out on the basis of experience. You can help work them out, help modify the system when and as it needs modification, and you can give health and agriculture authorities the benefit of your organized experience and advice. The proposed program presents another opportunity for the dairy industry and health agencies to extend their close working relationship in their common purpose of furnishing a high quality milk supply for the improvement of public health.

Milk Sanitation Honor Roll for 1950-51

Sixty-four communities have been added to the Public Health Service "honor roll" of safe milk communities, and 24 communities on the previous list have been dropped. This revision covers the period from January 1, 1950, to December 31, 1951, and includes a total of 251 cities and counties.

Communities on the "honor roll" have complied substantially with the various items of sanitation required by the Milk Ordinance and Code Recommended by the United States Public Health Service. The State milk sanitation authorities concerned must report this compliance to the Public Health Service. The rating of 90 percent or more, which is necessary for inclusion on the list, is computed from the weighted average of the percentages of compliance. Separate lists are compiled for communities in which all market milk is pasteurized and for those in which both raw and pasteurized milk is sold.

The Public Health Service Milk Ordinance, which forms the basis for the milk ratings, is now in effect through voluntary adoption in 387 counties and 1,535 municipalities. These represent increases of 18 and 43, respectively, in the past 6 months. The ordinance has been adopted as regulation by 34 States and 2 Territories. In 11 States and the 2 Territories it is in effect State-wide.

Although the ratings do not represent a complete measure of safety, they do indicate how closely a community's milk supply conforms to the standards for grade A milk as stated in the Public Health Service Milk Ordinance. High-grade pasteurized milk is safer than high-grade raw milk because of the added protection of pasteurization. The second list, therefore, shows the percentage of pasteurized milk in a community.

Although semiannual publication of the list is intended to encourage communities operating under the Public Health Service Ordinance to attain and maintain a high level of enforcement of its provisions, no comparison is intended with communities operating under other milk ordinances. Some communities might be deserving of inclusion, but they cannot be listed because no arrangements have been made for determination of their ratings by the State milk sanitation authority concerned. In other cases, the ratings which were submitted have lapsed because they were over 2 years old. Still other communities, some of which may have high-grade milk supplies, have indicated no desire for rating or inclusion.

This compilation is from the Division of Sanitation of the Bureau of State Services, Public Health Service. The previous listing, with a summary of rules under which a community is included, were published in Public Health Reports, August 24, 1951, pp. 1086–1090. The rating method was described in Public Health Reports 53: 1386 (1938). Reprint No. 1970.

Communities Awarded Milk Sanitation Ratings of 90 Percent or More, 1950–51

100 PERCENT OF MARKET MILK PASTEURIZED

Community	*Date of rating*
ALABAMA:	
Auburn	Sept. 19, 1951
Montgomery	May 11, 1950
Opelika	June 15, 1950
ARKANSAS:	
Fort Smith	Oct. 19 1951
COLORADO:	
Colorado Springs	June 6, 1951
Cortez	July —, 1950
Durango	July —, 1950
Grand Junction	Mar. 29, 1950
Pueblo	Aug. —, 1951
FLORIDA:	
St. Petersburg	Jan. 12, 1950
GEORGIA:	
Albany	May 18, 1951
Atlanta	Nov. 21, 1951
GEORGIA—Continued	
Cairo	May 31, 1951
Calhoun	Feb. 15, 1951
Columbus	Mar. 30, 1951
La Grange	June 25, 1951
Quitman	May 30, 1951
Waycross	Oct. 23, 1951
West Point	June 22, 1951
ILLINOIS:	
Chicago	Aug. 1, 1951
Decatur	Apr. 27, 1950
East Moline	May 18, 1950
Joliet	July 14, 1950
Moline	May 18, 1950
Peoria	Apr. 15, 1950
Rock Island	May 10, 1950
Silvis	May 18, 1950

Communities Awarded Milk Sanitation Ratings of 90 Percent or More, 1950–51—Continued

100 PERCENT OF MARKET MILK PASTEURIZED

Community	Date of rating
INDIANA:	
Bedford-Orleans	Oct. —, 1951
Bluffton	Dec. 14, 1950
Calumet Region	June —, 1950
East Chicago	
Gary	
Hammond	
Whiting	
Cooperative Grade A Milk Program	July —, 1951
Boonville	
Holland	
Huntingburg	
Jasper	
Evansville	Oct. —, 1951
Indianapolis	Aug. —, 1951
Madison	Oct. —, 1951
Marion and Gas City	Apr. —, 1951
Rushville	Aug. —, 1951
Shelbyville	Aug. —, 1951
South Bend	Aug. 14, 1951
Vincennes	May —, 1951
IOWA:	
Clinton	July 12, 1950
Des Moines	July —, 1951
KANSAS:	
Dodge City	Apr. 11, 1951
Erie	May 1, 1951
Hillsboro	Feb. 8, 1951
Kansas City	Dec. 11, 1950
Pittsburg	Jan. 26, 1951
KENTUCKY:	
Bowling Green and Warren County	July 13, 1950
Campbell County-Newport	Nov. 28, 1951
Christian County	Dec. 20, 1951
Hopkinsville	Mar. —, 1950
Mayfield and Graves County	May 11, 1950
Mount Sterling	Aug. 16, 1950
Murray	Apr. 19, 1950
Owensboro	Nov. 17, 1950
Paducah	May 5, 1950
Paris	May 17, 1951
LOUISIANA:	
Vermilion Parish	Sept. 9, 1951
MISSISSIPPI:	
Aberdeen	Oct. 26, 1951
Amory	Oct. 25, 1951
Belmont	July 12, 1951
Booneville	Sept. 28, 1951
Columbus	Aug. 13, 1951
Corinth	June 6, 1951
Iuka	July 12, 1951
Louisville	Oct. 4, 1951
Okolona	May 29, 1951
Tupelo	Apr. 20, 1951
MISSOURI:	
Cape Girardeau	Oct. 25, 1950
Chillicothe	Oct. 8, 1950
Columbia	Dec. 13, 1950
Concordia	June 7, 1950
Eldon	Dec. 14, 1950
Jackson	Oct. 25, 1950
St. Joseph	June 14, 1951
NEVADA:	
Yerington	Dec. 5, 1951
NORTH CAROLINA:	
Burke County	June 28, 1951
Charlotte	Feb. 23, 1950
NORTH CAROLINA—Continued	
Cumberland County	Feb. 10, 1950
Durham County	June 8, 1950
Forsyth County	Nov. 22, 1950
High Point	Feb. 16, 1951
Mitchell County	Aug. 10, 1951
New Hanover County	June 16, 1950
Randolph County	Mar. 9, 1951
Richmond County	May 29, 1951
Scotland County	May 31, 1951
Transylvania County	Jan. 16, 1950
Wilson	Aug. 2, 1950
Yancey County	Aug. 10, 1951
OKLAHOMA:	
Ardmore	July 28, 1950
Cushing	Feb. 10, 1950
Duncan	Oct. 4, 1950
Guthrie	May 26, 1950
Sulphur	Aug. 29, 1950
SOUTH DAKOTA:	
Sioux Falls	Oct. 12, 1951
TENNESSEE:	
Athens	June 14, 1950
Bristol	Oct. 19, 1951
Clinton	Nov. 28, 1951
Columbia	Apr. 20, 1950
Cookeville	Nov. 14, 1951
Covington	Aug. 15, 1950
Dandridge	Sept. 17, 1951
Dyersburg	Aug. 17, 1950
Erwin	Oct. 15, 1951
Fayetteville	June 27, 1951
Franklin	May 5, 1950
Gallatin	May 11, 1951
Jefferson City	Sept. 25, 1951
Kingsport	Oct. 23, 1951
Knoxville	Aug. 22, 1951
Lawrenceburg	Aug. 21, 1950
Lebanon	July 19, 1950
Lewisburg	Apr. 17, 1950
Manchester	Oct. 5, 1950
Memphis	June 5, 1951
Morristown	Sept. 25, 1951
Nashville and Davidson County	Nov. 5, 1951
Newbern	Aug. 16, 1950
Newport	Sept. 18, 1951
Paris	Apr. 18, 1951
Pulaski	May 24, 1951
Springfield	May 8, 1951
Sweetwater	Oct. 19, 1950
TEXAS:	
Bay City	May 4, 1950
Brenham	July 26, 1951
College Station	Sept. 20, 1950
Corpus Christi	Oct. 14, 1950
Dallas	Apr. 26, 1951
Falfurrias	Jan. 12, 1951
Gladewater	Jan. 19, 1951
Harlingen	Aug. 4, 1951
Houston	June 30, 1950
Jacksonville	Apr. 12, 1950
Kilgore	Jan. 19, 1951
La Feria	Aug. 2, 1951
Lamesa	May 10, 1951
Lovelland	May 9, 1951
Lufkin	Oct. 8, 1951
Mercedes	Aug. 21, 1951
Mission	Aug. 24, 1951

Communities Awarded Milk Sanitation Ratings of 90 Percent or More, 1950–51—Continued

100 PERCENT OF MARKET MILK PASTEURIZED

Community	*Date of rating*
TEXAS—Continued	
Pharr	Aug. 22, 1951
San Antonio	Mar. 11, 1950
San Benito	Aug. 1, 1951
San Juan	Aug. 23, 1951
Sweetwater	Apr. 19, 1950
Texarkana	Aug. 5, 1950
Texas City	Jan. 16, 1951
Tyler	Oct. 9, 1951
Weslaco	Aug. 24, 1951
Wichita Falls	Jan. 31, 1951
UTAH:	
Delta	Nov. 17, 1950
Minersville	Jan. 25, 1951
Ogden	Dec. 11, 1951
VIRGINIA:	
Boydton	Apr. 4, 1950
Bristol	Oct. 19, 1951
VIRGINIA—Continued	
Buena Vista	May 8, 1951
Front Royal	Aug. 29, 1951
Lawrenceville	Apr. 6, 1950
Lexington	May 8, 1951
Luray	Aug. 29, 1951
Pulaski	June —, 1950
Radford	June —, 1950
Richmond	May —, 1950
Roanoke	Sept. 23, 1950
Staunton	Nov. 3, 1950
Suffolk	May 24, 1950
Waynesboro	Aug. 3, 1951
WASHINGTON:	
Everett	June 14, 1951
Spokane	July 21, 1950
Whitman County	Aug. 16, 1950

Communities Awarded Milk Sanitation Ratings of 90 Percent or More, 1950–51

BOTH RAW AND PASTEURIZED MARKET MILK

Community and percent of milk pasteurized	*Date of rating*
ALABAMA:	
Huntsville, 98	Aug. 10, 1951
Lanett, 97.5	Nov. 9, 1950
GEORGIA:	
Camilla, 78	May 30, 1951
Cartersville, 94.2	Feb. 15, 1951
Dalton-Whitfield County, 83.3	Apr. 4, 1951
Macon, 98.6	June 15, 1951
Thomaston, 79.7	May 24, 1950
Thomasville, 99.4	May 29, 1951
INDIANA:	
Michigan City, 98.1	July —, 1951
IOWA:	
Davenport, 99	Jan. 27, 1950
KANSAS:	
Neodesha, 85	Mar. 14, 1951
KENTUCKY:	
Lexington and Fayette County, 96	June 23, 1950
LOUISIANA:	
Iberia Parish, 96	May 3, 1951
MISSISSIPPI:	
West Point, 97.6	July 18, 1951
MISSOURI:	
Boonville, 87	Oct. 12, 1950
Jefferson City, 88.5	July 20, 1950
Springfield, 99	Nov. 10, 1950
NORTH CAROLINA:	
Alexander County, 73.5	Mar. 31, 1950
Buncombe County, 95.8	June 15, 1951
Cabarrus County, 73.4	Jan. 20, 1950
Caldwell County, 88.7	Oct. 29, 1951
Greensboro, 99.7	July 27, 1950
Henderson County, 86	Feb. 6, 1950
Iredell County, 95.7	Oct. 27, 1950
NORTH CAROLINA—Continued	
King Mountain, 83.4	Nov. 16, 1951
Macon County, 91.4	Aug. 10, 1950
Montgomery County, 93.1	Mar. 22, 1951
Orange County, 96.1	May 11, 1950
Wilkes County, 90.6	Sept. 20, 1951
OKLAHOMA:	
Elk City, 95.5	July 12, 1950
Holdenville, 89	Mar. 28, 1950
Lawton, 96.2	Feb. 20, 1950
Mangum, 93.8	June 29, 1950
Norman, 94.1	Sept. 22, 1950
Ponca City, 93.1	Sept. 15, 1950
SOUTH CAROLINA:	
Spartanburg and Spartanburg County, 91.3	Oct. 31, 1951
TENNESSEE:	
Cleveland, 94.4	Sept. 7, 1950
Elizabethton, 94	Aug. 8, 1950
Harriman, 90.6	July 26, 1951
Jackson, 95.8	Mar. 30, 1950
Johnson City, 96.6	Aug. 9, 1950
Maryville-Alcoa, 99.2	Oct. 17, 1950
McMinnville, 95.1	May 25, 1950
Murfreesboro, 98.7	July 6, 1951
TEXAS:	
Amarillo, 95	July 23, 1951
Austin, 97.3	Oct. 24, 1951
Beaumont, 99.4	Oct. 20, 1950
Brenham, 94.9	July 26, 1951
Brownsville, 92.7	Aug. 1, 1951
Bryan, 98.8	Sept. 21, 1950
Cleburne, 91.5	Nov. 17, 1950
Corsicana, 99.7	July 9, 1951
Edinburg, 93.8	Aug. 28, 1951

Communities Awarded Milk Sanitation Ratings of 90 Percent or More, 1950–51—Con.

BOTH RAW AND PASTEURIZED MARKET MILK

Community and percent of milk pasteurized	*Date of rating*
TEXAS—Continued	
Fort Worth, 99.95	Feb. 4, 1950
Kerrville, 98.2	May 1, 1951
Laredo, 62	Aug. 24, 1950
Longview, 99.4	Jan. 19, 1951
Lubbock, 99.2	Nov. 8, 1950
Marshall, 88	July 6, 1951
McAllen, 99	Aug. 22, 1951
Paris, 92.3	Sept. 26, 1951
Sherman, 93.3	Nov. 6, 1951
VIRGINIA:	
Emporia, 34	Apr. 7, 1950
Lynchburg, 98.2	June 22, 1951
WASHINGTON:	
Seattle-King County, 99.6	June —, 1951

NOTE: In these communities the pasteurized market milk shows a 90-percent or more compliance with the grade A pasteurized milk requirements and the raw market milk shows a 90-percent or more compliance with the grade A raw milk requirements of the Public Health Service Milk Ordinance and Code.

Note particularly the percentage of milk pasteurized in the various communities listed. This percentage is an important factor to consider in estimating the safety of a city's milk supply. All milk should be pasteurized or boiled, either commercially or at home, before it is consumed.

Tuberculosis Control in India

A new training center with modern equipment for tuberculosis control and treatment is to be opened in New Delhi.

WHO is providing an international team, a bacteriologist, an epidemiologist, a laboratory and X-ray expert, and a public health nurse. A local team of these specialists is also being provided by the Tuberculosis Association of India.

A mobile unit provided by the United Nations International Children's Emergency Fund for mass radiography has been used to examine 16,000 of the 27,000 inhabitants of the town of Faridabad, and 4,000 staff members and students in the Delhi hospitals and other institutions.

Training in tuberculosis control will include lectures and practical work in the laboratory and clinic, and in the homes of the patients. The program will (1) determine the exact extent of the tuberculosis situation in urban and rural communities, (2) protect young people through BCG vaccination, and (3) continue and expand home treatment and supervision of patients unable to go to sanitoriums.

The center will be an extension of the existing clinic of the Tuberculosis Association of India in the Irwin Compound and under the direction of Dr. B. K. Sikand.

Another training center with international assistance is operating in Trivandrum. A third center is expected to open in Patna, the WHO regional office for South East Asia reports.

Ideas

IDEAS are for you and from you. In this section we want to report on new techniques and ways of doing things—new ideas in public health practice. The emphasis is on method, procedure, tools, concepts, and the practical solutions to everyday problems: new twists and adaptations, for example, on maintaining two-way communication between the people we work with; on records systems and stock control; on epidemiology, program planning, and budget control; on assembling, timing, conduct of prenatal classes, and follow-up of school health examinations . . . the list has no end. We are looking for ideas—large or small—that have helped you and might help others in health departments, hospitals, voluntary health agencies, schools, and so on. If you feel that a place of exchange such as this will be useful, let us hear from you—with ideas.

—THE EDITORS

County PHN Boards

MINNESOTA. Down-to-earth ideas on how to make a county public health nursing advisory board realize its full potential in community health are summarized in a manual of the State Health Department. The boards are part of county government. Members include a commissioner, the superintendent of schools, the health officer or a physician, usually a dentist, and several other "residents of the county."

The manual points up the responsibilities of the board in the administration of public health nursing services and in interpreting health needs and programs to the community. It discusses the board's organization and function (a draft constitution is included) the recruiting of a nurse, and what to do while a vacancy interrupts services. Included are practical ideas of how to help the nurse with her job and how to go about program planning. On-the-job training, work with student and practical nurses, and the importance of clerical assistance are stressed.

Cardiac Course for GPs

NEWARK, N. J. For the second year general practitioners are being given an opportuntiy to become familiar with the newer knowledge and techniques of early cardiac case finding. The program began at St. Michael's Hospital in 1950. Announcement of the course resulted in 600 applications, although facilities permitted only 75 participants. The current course has 81 students selected from the original applicants.

The course consists of 20 full-day sessions, each with a 2-hour lecture plus ward rounds and clinics. Groups of seven physicians were given special training sessions in fluoroscopy, electrocardiography, and pathology. For physicians who exhibited unusual interest, additional special courses have been provided.

Traveling expenses are borne by the physicians, who also pay a $5 fee. Students were selected on a geographic basis and it has been observed that those having to come the greatest distances are the most faithful in attendance. Many physicians have remarked on the value of the course to their practice of medicine. A number have noted that their prestige has been raised in the eyes of their patients. To aid in explaining the absence of physicians from their communities a day each week, local press announcements are contemplated.

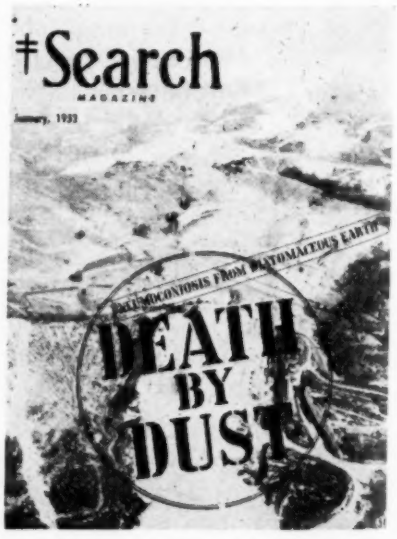
From the 1950 group, six physicians are now contributing their services to heart clinics, where the attendance has greatly increased because of the greater number of referrals from physicians from all parts of the State.

Staff members active in developing this course included Drs. Nicholas Antonius and Harrold Murray, presidents-elect of the Essex County and of the New Jersey State Medical Societies, respectively, and Dr. Bernard O'Connor. The work is actively supported by the New Jersey State Department of Health, Dr. Daniel Bergsma, commissioner, and Dr. Marion R. Stanford, chief of the section on heart diseases.

"Search" for News

CALIFORNIA. "Issued in the interest of Public Health by your local tuberculosis association" is *Search Magazine*, journal of the California Tuberculosis and Health Association. It appears monthly in news magazine style and reports in text and pictures (and in two colors) the health developments in California and the West.

A recent issue (see reproduction of cover) told the story of "bloody 99," the Sacramento-to-Los Angeles highway with 211 fatalities and 2,682 casualties in 1950; reported on the December clinical session of the American Medical Association; recorded in pictures (from San Diego)



the work of the public health nurse; discussed malpractice; commented on the aging population and the needs of children; and reported on pneumoconiosis from diatomaceous earth, as well as other health news of the month.

Search, first issued in June 1951, is directed by an editorial board of 10 members including 4 physicians. It was conceived to present health news to both physicians and nonmedical health workers. Of the circulation of nearly 30,000 copies, more than 16,000 go to physicians.

Civil Defense Nursing

MARYLAND. The experience of nurses who attended an institute on nursing aspects of atomic warfare in Rochester, N. Y., has been drawn upon in developing a training program in Baltimore and outlying counties. With the help of the nurses who attended the advance course, the State health department developed, in manual form, a suggested training course. So far, some 3,000 professional nurses have received initial civil defense training. Included are many inactive nurses as well as those currently employed in industry, hospitals, private duty, public health, and as student nurses.

Rabies Control

VIRGINIA. Working from a 1948 ordinance requiring vaccination of all dogs, Pittsylvania County has cut reported rabies cases from 38 to 1 in a single season. Public health clinics for vaccination were set up at 91 stations. Printed placards with clinic schedules were posted.

The Virginia Department of Health purchased a well-tested vaccine in bulk, and distributed it to veterinarians locally. They in turn repaid the State out of clinic fees of 75 cents per dog. Certificates of vaccination were provided dog owners by the veterinarians. During the program, uncontrolled dogs were taken into custody, and strays were destroyed.

On the Trail

ATLANTA. The cartoon strip technique is being used to explain technical sewage treatment processes to people without technical training. It is the work of Ed Dodd, creator of the comic strip "Mark Trail."

He has done a series of pictures in which Mark, his young friend Scotty, and their dog Andy are shown through a sewage treatment plant by an engineer. In a combination of drawings and readable text, Mr. Dodd makes the step-by-step process of sewage treatment clear to adults and young people alike, without sacrifice of technical accuracy.

The sequence reproduced here appears in a new 16-page full-color cartoon book, "The Fight to Save America's Waters," drawn as a public service by Mr. Dodd. The booklet is available through State water pollution authorities.

Mongoose Rabies in Puerto Rico

By ERNEST S. TIERKEL, D.V.M., M.P.H., GUILLERMO ARBONA, M.D., M.P.H., ALFONSO RIVERA, D.V.M., and ABEL de JUAN, M.D., M.P.H.

Rabies has been classified into two epidemiological types, the sylvatic or campestral type in wildlife and the disease as it is found in domestic dogs (*1*). In certain rural areas where rabies is enzootic, this epidemiological differentiation may not always be so discrete. The factors which influence the presence of both types simultaneously in a given area are the amount of contact between wild species and domestic dogs, the relative population sizes of both groups, and the immunity level of the domestic dog population.

Although the disease in dogs is still the principal rabies problem in most countries of the world today, mass canine immunization practices and other effective measures have brought about increasing control and eradication. Success with dogs has focused attention on the importance of various species of wild fauna in the spread and transmission of the disease.

In the Americas, rabies has been diagnosed sporadically in practically every kind of susceptible wild animal. In the United States, the principal large-scale sylvatic vectors of the disease have been the fox, genus *Vrocyon;* the skunk, genus *Mephitis* and genus *Spilogale;* and the coyote, *Canis latrans.* In South America, Central America, Trinidad, and Mexico, the vampire bat, *Desmodus rotundus*, is an important transmitter of rabies.

The first major outbreak of rabies in an area of the Western Hemisphere, attributed to the Indian mongoose, *Herpestes javanicus*, is presented in this report.

Dr. Tierkel is from the veterinary public health branch of the Communicable Disease Center, Public Health Service, Atlanta, Ga. Dr. Arbona and Dr. de Juan are from the Puerto Rico Health Department's division of public health and Dr. Rivera, from the veterinary division of the Puerto Rico Department of Agriculture, San Juan, P. R.

History of Rabies in Puerto Rico

Information on the early history of rabies in Puerto Rico is restricted, for the most part, to the laws for controlling the disease. The first edict, issued in 1841, ordered owners to kill immediately any animals showing signs of hydrophobia or any other contagious disease (*2–4*). This law was reprinted in 1874 after an outbreak of rabies in Bayamon, and in 1875

The Indian mongoose, *Herpestes javanicus* (family Viverridae), is a small carnivore, with a body 14 to 17 inches long and a tail 11 to 13 inches long. It averages about 1.5 pounds in weight. Its hair coat varies from brindle to tan-gray in color. An extraordinarily wily animal, its ferocity is matched only by its speed of movement, and it is famous for its ability to attack and overcome snakes, even the poisonous cobra in its native India. Mongooses are largely migratory in habit and have no specific home range. The average daily foraging range is estimated to be one-eighth to one-fourth of a mile (*11*). In its daily movements it prefers natural runs which are fairly well covered by overgrown brush.

after several cases were found at different places on the island.

In 1896, the occurrence of two human cases of rabies motivated the establishment of a histo-chemical-bacteriological institute at the city of Mayaguez (*5*). After the American occupation, general order No. 221, dated December 19, 1899, contained the following: "Any animal suspected of having hydrophobia should be killed instantly and burned or buried in a deep grave" (*2*).

From 1910 to 1949, 21 cases of rabies diagnosed by laboratory examination of suspected specimens (table 1) were reported by the Puerto Rico Department of Health and 1 case by the School of Tropical Medicine (*6*).

Although details regarding types of affected animals are not available for all the years, the only species mentioned in the literature are dogs and various types of farm animals. Until the present outbreak, Puerto Rico had been considered as one of the world's rabies-free areas, no case of rabies having been reported on the island since 1933.

Table 1. Laboratory examinations for rabies and reports of positive diagnosis by the Puerto Rico Department of Health

Fiscal year	Total specimens examined	Rabies positive
1910–11	[1]	[1]
1911–12	9	4
1912–13	17	2
1913–14	25	1
1914–15	[2]	[2]
1915–16	[1]	[1]
1916–17	[1]	[1]
1917–18	12	4
1918–19	12	3
1919–20	[1]	[1]
1920–21	[1]	[1]
1921–22	6	1
1922–23	[2]	[2]
1923–24	[2]	[2]
1924–25	5	1
1925–26	5	1
1926–27	[2]	[2]
1927–28	[2]	[2]
1928–29	7	4
1929–30	9	0
1930–31	9	0
1931–32	7	0
1932–33	[2]	[2]
1933–34 [3]	1	1
1934–35	[1]	[1]
1935–36	[1]	[1]
1936–37	[1]	[1]
1937–38	3	0
1938–39	2	0
1939–40	3	0
1940–41	[1]	[1]
1941–42	[1]	[1]
1942–43	[1]	[1]
1943–44	[1]	[1]
1944–45	[1]	[1]
1945–46	[1]	[1]
1946–47	[1]	[1]
1947–48	15	0
1948–49	25	0
Total	172	22

[1] None recorded.
[2] Data not available.
[3] Examination performed at School of Tropical Medicine, San Juan.

The Present Outbreak

The first known case of the present outbreak was diagnosed in a dog March 22, 1950, on a small farm in Barrio Monacillo of the municipality of Rio Piedras. The animal had shown typical clinical symptoms and had bitten several persons and animals on the farm. A hog, bitten by this first rabid dog, subsequently died of rabies. All persons bitten received the complete series of Semple antirabic vaccinations. The next 3 months marked the occurrence of seven cases: four dogs, one hog, one calf, and one cat. The bizarre geographic distribution involved five widely scattered foci of infection including two barrios in Rio Piedras and one each in Ciales, Toa Alta, and Ponce. The diagnosis of these initial cases was confirmed by the Communicable Disease Center laboratory at Montgomery, Ala., and the School of Tropical Medicine, San Juan, P. R.

Thorough investigation revealed that all of the cases were rural and in no instance was there evidence that the involved foci had as a source of infection any one animal contact which was common to all. Nor was there any evidence to support the hypothesis that any one or several of the cases had stemmed from a recent importation of infected pet animals. The striking fact about the investigation was that all of the originally infected dogs and the cat in the five foci had fought with mongooses within a period varying from 2 weeks to 2 months before clinical illness. This was the first epidemiological suggestion that rabies might be present in the mongoose population and that it possibly was being transmitted from the mongoose to domestic animals.

Several mongooses were trapped and exposed to experimental infection in order to determine

Table 2. Rabies cases in Puerto Rico diagnosed by laboratory examination, March 22, 1950, to September 18, 1951

Animals	1950										1951									Total
	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	
Mongoose	0	0	0	0	0	0	0	4	4	4	2	5	0	2	1	8	2	4	1	37
Dog	1	1	1	1	0	0	3	2	1	0	4	0	0	0	0	0	3	0	1	18
Other [1]	0	1	2	0	0	0	0	2	1	2	0	1	0	2	3	3	3	2	1	23
Total	1	2	3	1	0	0	3	8	6	6	6	6	0	4	4	11	8	6	3	78

[1] Cats, cattle, horses, goats, swine.

their relative susceptibility and to study the clinical pattern of rabies in these animals. Infected brain suspensions were inoculated intramuscularly (total dose of 0.4 cc., 10-percent suspension, intramasseter) with several of the Puerto Rican strains of virus obtained from the original cases. Two of four inoculated mongooses became infected after incubation periods of 22 and 23 days, respectively. They exhibited progressively typical, if exaggerated, symptoms of furious rabies which lasted 4 and 6 days, respectively, until death.

Like most other wild animals, the normal mongoose has a natural fear of man and many other animals. When it is cornered or caged, however, it becomes extremely vicious. At the height of clinical rabies, it exhibits extraordinary symptoms of hyperexcitability and ferocity. Both of the infected animals suffered broken teeth, lacerated muzzles, and severe oral trauma from biting at the wire and frame walls of their cages. The terminal paralysis which ensued was swift and overwhelming. Negri bodies were demonstrated upon direct microscopic examination, and virus was isolated from the brains and salivary glands of both animals.

Pilot trapping operations were then set up in and around the reported infected areas. The first two naturally infected mongooses were found October 18 and 20, 1950, at Fort Buchanan in the municipality of Bayamon. These had been captured after unprovoked attacks on personnel and animals on the military reservation.

Stimulated by a campaign of public information, increasing reports of clinically rabid mongooses that exhibited signs of unusual bravado and ferocity began to come into the health department. Corresponding increases in the number of mongoose brains submitted to the laboratory followed. From the onset of the outbreak March 22, 1950, to September 18, 1951, a total of 78 cases of rabies was confirmed by laboratory examination. These included 37 cases in mongooses, 18 cases in dogs, and 23 cases in cats and livestock (table 2). All of the cases were restricted to rural areas and were distributed throughout the island with no significant geographic pattern. Since the beginning of the outbreak, 104 treatments of Semple human antirabic vaccinations have been administered by the health department. The chain of events with regard to the occurrence and spread of the infection established it as primarily an epizootic of rabies in the mongoose population with secondary transmission to dogs and other domestic animals. There is no evidence that the disease has, as yet, become entrenched in the canine population with urban involvement and significant dog-to-dog transmission. Most of the livestock cases which were investigated were caused by exposure from rabid mongooses.

Immediately after the outbreak, emergency control measures were put into effect to prevent the spread of the disease in the large and susceptible dog population. These programs included a thorough census of all dogs, the collection, impoundment, and humane destruction of all ownerless and stray dogs, and the vaccination of all other dogs in the original zones of infection which included an area covering a radius of 3 to 5 kilometers from the focal case. Since Rio Piedras and San Juan were not far

from this area, a similar campaign was carried out in these cities.

As the reports of cases began to come in from other parts of the island, the same intensified control, with emphasis on dog vaccination, was extended to all affected areas. Although mongoose and livestock cases continued to occur in some of the previously infected areas, in no instances were there any cases in dogs in areas where a canine rabies-control program had been conducted. Further evidence of the effectiveness of measures to prevent the disease from becoming established in the dog population is demonstrated by the fact that from January 29 to July 5, 1951, there were no cases reported in dogs, while there were 17 cases in mongooses, 3 in cattle, 4 in horses, and 2 in goats.

Plans were drawn to control the disease in the mongooses of the island by a mongoose trapping program. Two types of traps were put into use, one made of wood and hardware cloth and the other, of simpler design, entirely of wood. Both types employ the principle of placing an attractive bait on a device inside the trap which, when disturbed, springs a trap door shut. Approximately 3,000 traps have been constructed as models and distributed to centers throughout the island. An island-wide program now in operation consists primarily of the training and education of the public for the trapping of mongooses in rural areas of the island. Training centers have been established and training carried out by local health units, 4-H clubs, and agricultural extension services.

Characteristics and Habitat

The mongoose is not native to Puerto Rico or to the other islands of the Carribean. It was imported from India to Jamaica during the middle of the nineteenth century by sugar planters to destroy the rats which were causing large economic losses in the cane fields. Jamaica apparently served as a distributing point for far-flung exportation. They were introduced into Puerto Rico between 1870 and 1877 (*7*) and into Hawaii about 1883 (*8*).

The mongoose has been of little or no value as a biological means of rat control, Spencer points out in his studies in the Territory of Hawaii. In comparing the rat populations of the principal islands on which the mongooses were introduced with those of the islands of Lanai and Kauai where they were not released, he shows that the over-all rat population densities remained the same. This species of mongoose is diurnal in habit while the rat is nocturnal. Their paths rarely cross. Furthermore, Spencer says, the mongoose is as much of a scavenger as a predator, has no aversion to feeding on carrion, and will try to obtain his food in the easiest way possible (*9*).

The experience in the West Indies has been much the same, and over the years it was found that the mongoose, rather than being an asset, has been a liability. It has greatly reduced, and even exterminated, most species of ground-nesting birds by preying on eggs, nestling birds, and adults. It has also reduced great numbers of beneficial insectivorous lizards and toads and has been a serious pest of poultry by decimating young chicks and eggs. As a result, most of the islands have, from time to time, attempted to initiate mongoose reduction programs, usually by some kind of bounty scheme, with varying degrees of success (*10*). Now that the animal has been proved an important disease vector, interest in devising effective reduction programs has been revived.

Although this species abounds in India, it has not been listed as an important vector of rabies in that country, where the jackal is the principal wild host and transmitter of the disease (*12*). However, in South Africa, other species of the family Viverridae are described as important vectors of rabies. These veld carnivora include the yellow mongoose, *Cynicits penicillata;* the suricate, *Suricata suricatta;* the small gray mongoose, *Myonax pulverulentus;* and the genet cat, *Geneta felina.* The first two are burrowing animals while the latter two are not (*13–15*). The South African types of mongooses often are referred to as meercats.

Summary

1. Puerto Rico is experiencing an outbreak of rabies which began with the first reported case March 22, 1950.

2. This was the first case of rabies reported

since October 15, 1933, with only sporadic cases having been diagnosed in the years before that time.

3. A thorough study of the outbreak has established it as primarily an epizootic of rabies in the mongoose population of the island with secondary transmission to dogs and other animals.

4. This is the first major outbreak of rabies in the Western Hemisphere attributed to the Indian mongoose, *Herpestes javanicus*.

ACKNOWLEDGMENTS

The authors express their appreciation to Health Commissioner Juan A. Pons for making this study possible; to Martha Eidson, Dr. Enrique Koppisch, Manuel Betances, and Antonio Puras for their assistance in the diagnostic phases of this work; to Dr. Enrique Toro, Jr., Dr. Aurelio Malaga Alba, and William Buren for their active participation in the control activities; to George A. Seaman, Nelson Biaggi, Luis Hernandez Aquino, José Ramos, and Dr. Virgilio Biaggi for supplying important sources of historical and scientific information.

REFERENCES

(1) Johnson, Harald N.: Methods of rabies control. Proc. 4th Internat. Cong. Trop. Med. 1: 587–594 (1948).

(2) Bagué, Jaime: Personal communication.

(3) Bando de Policia y Buen Gobierno de la Isla de Puerto Rico 1841, art. 83.

(4) Bando de Policia y Buen Gobierno de la Isla de Puerto Rico No. 76 de 1849, art. 196.

(5) Costa-Mandry, O.: El laboratorio biologico como factor de progreso medico en Puerto Rico. Bol. Asoc. mèd. de Puerto Rico 24: 425–449 (1932).

(6) Reports of the commissioner of health to the governor of Puerto Rico, 1910–11 through 1948–49.

(7) Archives of the assistant engineer, Porto Rico district, San Juan, P. R., 1912.

(8) Doty, R. E.: Rat control on Hawaiian sugar cane plantations. Hawaiian Sugar Planters' Record 49: 71–239 (1945).

(9) Spencer, H. J.: Unpublished report on Hawaiian rat control project, U. S. Fish and Wildlife Service, Dec. 1935–June 1938.

(10) Myers, J. G., and Urich, F. W.: The mongoose. Trop. Agriculture 8: 94–97 (1931).

(11) Spencer, H. J.: Mongoose control research project. Unpublished report. U. S. Fish and Wildlife Service, Virgin Islands, October–November 1950.

(12) Fagan, Raymond: Rabies in animals other than dogs. CDC Bull. 9: 10, 11 (Oct. 1950).

(13) Snyman, P. S., and Thomas, A. D.: The carriers of rabies in South Africa. *In* Congrès International de médicine tropicale et d'Hygiène, 3d, Amsterdam, 1938. Acta Conventus Tertii de Tropicis Atgue Malariae Morbis, pars. I, pp. 616–638.

(14) Neitz, W. D., and Marais, I. P.: Rabies as it occurs in the Union of South Africa. 18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, 1932.

(15) Snyman, P. S.: The study and control of the vectors of rabies in South Africa. Onderstepoort. J. Vet. Sc. & Animal Indust. 15: 9–140 (1940).

Heart Center for Children

Plans for a new center to serve children with congenital heart malformations have been approved by the Children's Bureau, Federal Security Agency. This center, the second regional heart program of its kind, will be located in California and will serve children in that State, Arizona, Idaho, Nevada, Alaska, and Hawaii.

According to arrangements completed with the California State Department of Public Health, the center will use four hospitals, three in San Francisco, the Mt. Zion, Stanford, and University of California, and the Children's Hospital in Los Angeles.

The first heart center, approved last August, is in Connecticut and serves children from Connecticut and Rhode Island. Studies are now being made to determine the best locations for centers in the South, East, Midwest, and Southwest.

Expenditures of Health Departments In Large Cities

By ISADORE SEEMAN, M.P.H.

Adequate financial support for public health services is essential if the benefits of modern public health practices are to reach the people. Although it has often been said that public health is purchasable, there has been insufficient attention to the problem of setting the price. If appropriating bodies are expected to provide adequate funds, we should be prepared to offer sound objective standards against which the funds requested may be measured.

Health officers annually submit budget requests which include sums for many new positions. Budget officers annually reduce these requests, usually allowing necessary increments in salaries and here and there permitting the creation of additional jobs. All of us are familiar with the arithmetic of the budget office: the sum of the requests from all of the government departments exceeds anticipated revenue; therefore, unless new sources of income are sought there can be no other recourse than to cut the departmental requests. If health department officials hope to do more than bargain for an arbitrary share of the total appropriation for governmental services, efforts must be made to develop a more rational and more precise approach to budget preparation and justification.

In recognition of the need for organized effort to insure adequate public funds for health services, the health council of the District of Columbia has adopted as one of its functions a program of study and action to develop community understanding and support for the budget needs of the official health department. A committee of lay persons, organized for this purpose, directed the author to prepare data to assist in such a study, with particular reference to comparisons of expenditures in other communities of comparable population size. This paper presents the data collected as a part of this study, together with a discussion of some of the problems in developing effective justifications for public health appropriations.

Mr. Seeman is the executive secretary of the health section, United Community Services, Washington, D. C.

Table 1. Health department expenditures in eleven large cities, 1920, 1930, 1948

City	Per capita expenditure			Rank	
	1948 [1]	1930 [2]	1920 [3]	1948	1920
Baltimore	$1.53	$0.91	$0.53	7	5
Boston	1.60	(4)	.48	5	6
Buffalo	[5] 1.74	.99	.71	2	3
Cleveland	[6] 1.26	(4)	.48	8	7
Detroit	1.13	1.16	.72	9	2
Milwaukee	1.66	1.02	.70	3	4
New Orleans	1.04	.54	.36	10	10
Philadelphia	.98	.61	.39	11	9
Pittsburgh	[6] 1.54	.92	.81	6	1
St. Louis	[6] 1.64	.63	.34	4	11
Washington	2.40	1.04	.45	1	8

[1] Source: Data secured by the author from the health department or social planning council of each city. [2] Source: Reference (*9*). [3] Source: Reference (*6*). [4] Data not available. [5] Erie County, including Buffalo. [6] Expenditures for 1949.

Table 2. Municipal income and expenditure in 10 large cities, 1948

City	Per capita income		Per capita operating expenditure		Percent of operating expenditure for health
	Total tax revenue	General borrowings	All services	Health services	
Baltimore	$ 55.82		$72.20	$1.53	2.1
Boston	105.15	$20.62	125.04	1.63	1.3
Cleveland	30.72	6.66	37.38	1.56	4.2
Detroit	53.93		71.17	1.12	1.6
Milwaukee	50.56		60.87	1.51	2.5
New Orleans	34.80	9.67	34.82	1.12	3.2
Philadelphia	42.91	16.96	39.86	.92	2.3
Pittsburgh	36.85	5.88	30.00	1.04	3.4
St. Louis	38.94	4.69	36.46	1.30	3.6
Washington	84.33		82.56	2.83	3.4

Source: Reference (*1*).

This study is limited to public health expenditures in large cities. For 33 of the largest cities in the United States, data collected by the U. S. Census Bureau for 1948 (*1*) show a median expenditure for public health services of $1.18 per capita. Detailed data on expenditures, by service and by source of funds, were collected by the author from 11 large cities which could furnish such figures. The aggregate population of these 11 cities was approximately 8 percent of the total United States population. In 1948, the median health department expenditure of these 11 cities was $1.54 per capita. These expenditures cover only the traditional activities of a health department and do not include programs of hospital or medical care. There was a considerable range in total expenditure among these 11 cities, with a low of 98 cents per capita and a high of $2.40 (table 1).

Factors Influencing Health Expenditures

What factors determine the amount of funds appropriated to the health department in any community? Obviously many complex factors may play a part. Some of the measurable factors which might possibly have a relationship to total municipal expenditures for health services were studied for 10 cities. (Buffalo was excluded from this analysis because comparable data were not available.)

There appears to be a definite relationship between the per capita amount spent for health and total municipal revenue from taxes (table 2). When the cities were ranked according to health expenditure and grouped as the highest or lowest three and middle four, 7 of the 10 cities fell into identical groups when health expenditure was compared with tax revenue. This relationship is illustrated by comparing the figures for 1948 for Baltimore, which had a per capita health expenditure of $1.53 and a per capita tax revenue of $55.82, with those for Pittsburgh, where the health expenditure was $1.04 and tax revenue was $36.85 per capita (table 2). Health expenditures were also related to per capita total municipal operating expenditures for all purposes. Six cities fell into identical groups according to these two factors. This suggests a conclusion which, while rather obvious, is nevertheless important: a city may be expected to appropriate funds for health services in relation to total funds secured from its basic revenue source and to total funds available for all operating services. This principle is further supported by the fact that health expenditures do not rank highest in those cities where borrowing is greatest.

How much should a community spend for its public health program? The committee on local health units of the American Public Health Association considered that approximately $1 per capita, based on the 1942 purchasing power of the dollar, would be required "to assure basic and reasonably adequate local health services" and that $2 or $2.50 per capita might be needed "to provide also such addi-

tional services as may be found to be locally desirable and considered to be essential for an optimum local health service of comprehensive scope and superior quality" (*2*). Emerson found that for the Nation as a whole in 1942 actual expenditures for local health services were only 65 cents per capita. Recognition was given at that time to the need to adjust the recommended figures as the dollar value changed, and in a discussion in the 1947 American Public Health Association meeting (*3*), it was suggested that the $1 minimum per capita be raised to $1.50 in view of the increased cost of providing the same basic services. On this basis a more adequate budget would require $3 or $3.75 per capita.

An analysis of the relationship between an index of purchasing power and per capita health expenditure in the 11 cities studied reveals that those cities with a higher cost of living tend to spend more per capita for health. However, adjustment of the actual health department expenditure in these cities for differences in the cost of living suggests the inadequacy of appropriations for health services (table 3). If the minimum per capita need of $1.50 is used for the city with the lowest cost of living index, the city with the highest living cost would require not $1.50 but $1.71 per capita to provide the same services, assuming the cost of health service bears a relationship to the cost of living. When actual expenditures are adjusted for the cost of living factor, only four of the 11 cities exceed their minimum need.

Table 3. Per capita health department expenditures adjusted for cost of living in 11 large cities, 1948

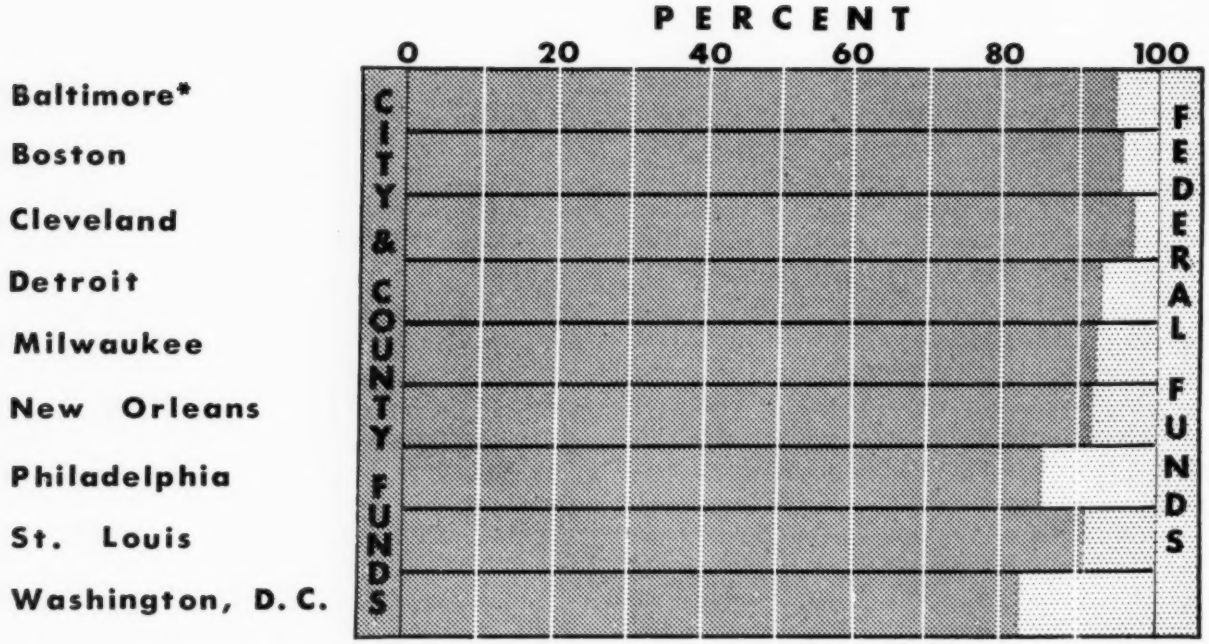
City	Family cost of goods and services, 1947 [1]	Per capita health department expenditure	
		Minimum need adjusted for cost of living [2]	Actual expenditure, 1948
Baltimore	$2,944	$1.62	$1.53
Boston	2,981	1.64	1.60
Buffalo	2,810	1.54	1.74
Cleveland	2,897	1.59	[3] 1.26
Detroit	2,974	1.63	1.13
Milwaukee	2,988	1.64	1.66
New Orleans	2,734	1.50	1.04
Philadelphia	2,867	1.57	.98
Pittsburgh	2,973	1.63	[3] 1.54
St. Louis	2,928	1.61	[3] 1.64
Washington	3,111	1.71	2.40

[1] Source: U. S. Department of Labor, Bureau of Labor Statistics, Workers budgets in the United States; Bulletin No. 927, 1948.
[2] Based on need of $1.50 for city having lowest cost-of-living index (New Orleans).
[3] Expenditures for 1949.

The observations on the relationship between health expenditure and total municipal operating cost suggest another possible approach to the establishment of a standard for a community's health expenditure. Should a city be asked to devote some recommended minimum percentage of its total expenditure to health services? For the 10 cities studied, the actual percentage in 1948 ranged from 1.3 to 4.2, with a median of 2.8 percent (table 2). It should be noted, however, that for these cities there is no significant relationship between the level of per capita health expenditures and the percentage of total city expenditures devoted to health. Boston, for example, allocated the smallest percentage of total expenditure to health, but ranked second among the 10 cities in per capita health expenditure.

We are forced to recognize the problem of city fiscal officers faced with requests for more funds than are available. The health department might seek an "equitable" share of the available funds. If such an allocation is still inadequate based on other criteria, the alternatives are to increase health appropriations at the expense of other municipal services, or to increase municipal revenue.

There is a striking relationship between a health department's expenditures in 1 year and the record of expenditures by the same health department in past years. This relationship is clear even when the expenditure in 1948 is compared with the expenditure in 1920. When the 11 cities are ranked, major shifts in relative positions are seen to have occurred over this 28-year period in only 4 cities (table 1). Two of the four cities whose rank shifted significantly also experienced radical population increases during the period, both over 90 percent. One city maintained the same rank in both 1948 and 1920, four cities shifted only one position in rank, and two cities shifted two positions. In short, a community spends for health services at the rate it is accustomed to maintain.



*State source of 0.3 percent.

Source of Local Health Department Funds

There is no significant relationship between per capita health department expenditures and the size of the city's population. This is true for the 11 cities studied as well as generally for larger and smaller cities. For the five largest cities in the United States which have populations over 1,000,000, the median per capita health expenditure in 1948 was $1.15; for eight cities between 500,000 and 1,000,000 population, it was $1.58; and for 20 cities between 250,000 and 500,000 population, the median expenditure was $1.11 per capita.

Of the major municipal functions, only libraries and penal institutions receive a lower per capita allocation than public health service. For 10 large cities, the 1948 Census Bureau tabulation shows a median health expenditure of $1.40 per capita. This compares with a per capita expenditure of $2.39 for public welfare, $2.87 for public recreation, $3.20 for highways, $3.76 for public hospital care, $5.73 for municipal sanitation (including garbage collection and disposal, street cleaning, and sewage disposal, but not including the public health sanitation services of food and milk control, environmental hygiene, and related activities), and $13.15 for public safety. The median expenditure for penal institutions was 78 cents and for public libraries was $1.16 per capita.

Seven of the 11 cities studied were included in the 1948 tabulation of total community health and welfare expenditures by community chests and councils of America (*4*). For these seven cities, the median per capita expenditure from public funds for all health and

Table 4. Percent of municipal health department expenditure by source of funds in 9 large cities, 1948

City	Source of funds (percent)	
	City and county	Federal
Baltimore [1]	94.3	5.4
Boston	95.5	4.5
Cleveland [2]	97.4	2.6
Detroit	93.7	6.3
Milwaukee	92.4	7.6
New Orleans	92.2	7.8
Philadelphia	85.1	14.9
St. Louis [2]	91.7	8.3
Washington	81.3	18.7

[1] Funds from State sources were reported only for Baltimore (0.3 percent).
[2] Expenditures for 1949.

hospital services was $9.48. The median health department expenditure in these seven cities was $1.64 per capita. It is thus apparent that the expenditure by the health department for traditional public health activities in these cities represents only a relatively small part of the public dollar spent for health care.

Source of City Health Department Funds

The large city health departments studied relied almost exclusively for their funds on local appropriations. In nine cities for which data were available a median of 92.4 percent of health department expenditures was derived from the city and county. State funds made available to the large city health departments reported on were negligible. This may not, in all cases, reflect services provided in the city by the State health department directly under State appropriation, but, in general, such services are very limited in metropolitan communities. Large cities do not depend on Federal funds for any significant proportion of their expenditure. The percentage of city health department expenditures derived from Federal grants ranged from 2.6 to 18.7, with a median of 7.6 percent (table 4). The highest percentage, 18.7, is for the District of Columbia, which, for its Federal grants, is treated as a State.

Expenditures by Service

It would be helpful to have available bases for justifying adequate appropriations for specific services. Suggestions have been made for minimum ratios of personnel to population in a number of public health fields (*2*). Another and more precise approach has been to develop personnel needs in man-hours, estimating the time required for each type of service and the units of service to be rendered. In illustration of this technique, the total number of environmental sanitation inspections required in the District of Columbia was estimated for 1952 at 190,795 visits. The record shows an average of 2,500 inspections per worker per year. Thus a need for 76 inspectors can be demonstrated.

It might be helpful if one could point to morbidity or mortality records as evidence of the need for adequate appropriations. Unfortunately the use of such justifications is accompanied by hazards. Where the death rate is high, the need for efforts to effect a reduction can be used to justify a large appropriation. On the other hand, where the mortality rate is low, in part as a result of earlier activities, there is a need to maintain control programs in order to avoid a relapse. Further, the reduction of a low mortality rate requires relatively greater effort than the reduction of a high rate. Thus, large appropriations can be justified by either a high or low mortality rate.

Table 5. Average percent and per capita expenditure of health departments by service, 1948, 1920

Service	Percent		Per capita	
	1948[1]	1920[2]	1948[1]	1920[2]
All services	100.0	100.0	$1.54	$0.48
Administration	7.1	6.7	.10	.03
Health education	.6	------	.01	------
Vital statistics	2.2	3.6	.04	.02
Laboratory	5.2	7.5	.07	.04
Sanitation	25.8	34.3	.39	.16
Medical and nursing	61.3	45.5	.79	.22
Nursing	28.8	2.3	.44	.01
Medical	28.5	43.2	.46	.21
Communicable disease	3.0	17.3	.07	.08
Tuberculosis	6.2	3.7	.10	.02
Venereal disease	5.8	1.7	.08	.01
Maternal, child	4.8	9.9	.07	.05
School	4.4	10.6	.09	.05
Other classification	3.9	------	.06	------
Other services	------	2.4	------	.01

[1] Source: Data collected by the author from 11 large cities. (Data for some services not available for all cities; the base therefore varies and the column cannot be totaled.)
[2] Source: Reference (*6*).

In the 11 cities studied, medical and nursing services accounted for a median of 61 percent of the total health department expenditures in 1948 (table 5). About half of this amount, 29 percent, was spent for nursing services. Sanitation programs accounted for 26 percent of all expenditures; laboratory services for 5 percent; and administration, vital statistics, and health education, for 10 percent.

Within the field of medical programs, the median percentages devoted to specific services were: tuberculosis, 6 percent; venereal disease, 6 percent; maternal and child health, 5 percent; school health, 4 percent; and communicable disease, 3 percent. Other programs, such as cancer

Table 6. Percent of total health department expenditures, by service in 11 large cities, 1948

Service	Baltimore	Boston	Buffalo	Cleveland [1]	Detroit	Milwaukee	New Orleans	Philadelphia	Pittsburgh [1]	St. Louis [1]	Washington
All services	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0
Administration	7. 0	7. 7	7. 2	(2)	8. 5	3. 8	12. 7	1. 8	3. 8	1. 7	7. 2
Health education	1. 4	------	1. 0	(2)	1. 8	1. 3	4. 5	------	------	------	. 3
Vital statistics	5. 8	1. 1	1. 6	5. 5	2. 5	2. 1	7. 1	2. 2	. 6	3. 8	1. 5
Laboratory	8. 0	3. 3	12. 5	4. 5	5. 2	5. 1	------	7. 4	3. 5	7. 0	5. 2
Sanitation	25. 8	24. 2	23. 6	28. 6	26. 3	25. 7	22. 0	26. 7	30. 2	40. 9	18. 2
Medical and nursing	52. 0	63. 7	54. 0	61. 3	55. 7	61. 9	53. 8	61. 9	62. 0	46. 6	67. 5
Nursing	30. 2	23. 7	30. 0	33. 9	(2)	32. 3	26. 7	(2)	27. 7	(2)	20. 8
Medical	21. 8	40. 0	24. 0	27. 4	(2)	29. 6	27. 1	(2)	34. 3	(2)	46. 7
Communicable disease	1. 8	4. 5	1. 7	(2)	(2)	4. 8	3. 0	(2)	5. 6	(2)	2. 9
Tuberculosis	6. 2	12. 3	6. 4	(2)	(2)	5. 6	4. 9	(2)	4. 5	(2)	9. 6
Venereal disease	7. 9	------	1. 8	(2)	(2)	3. 0	7. 4	(2)	5. 8	(2)	8. 8
Cancer	------	------	. 2	(2)	(2)	------	------	(2)	------	(2)	. 8
Maternal, child	4. 8	[3] 11. 1	2. 5	(2)	(2)	[3] 3. 8	8. 1	(2)	[4] 4. 3	(2)	11. 1
School	0. 7	(5)	7. 6	(2)	(2)	4. 1	. 4	(2)	[4] 14. 2	(2)	4. 8
Mental	------	------	------	(2)	(2)	------	------	(2)	------	(2)	2. 0
Dental	0. 2	(5)	3. 7	(2)	(2)	3. 0	1. 9	(2)	------	(2)	6. 7
Other classification	0. 2	12. 1	------	(2)	(2)	5. 3	1. 4	(2)	------	(2)	------

[1] Expenditures for 1949. [2] Data not available. [3] Child hygiene only. [4] Estimated figure.
[5] Included under other classification.

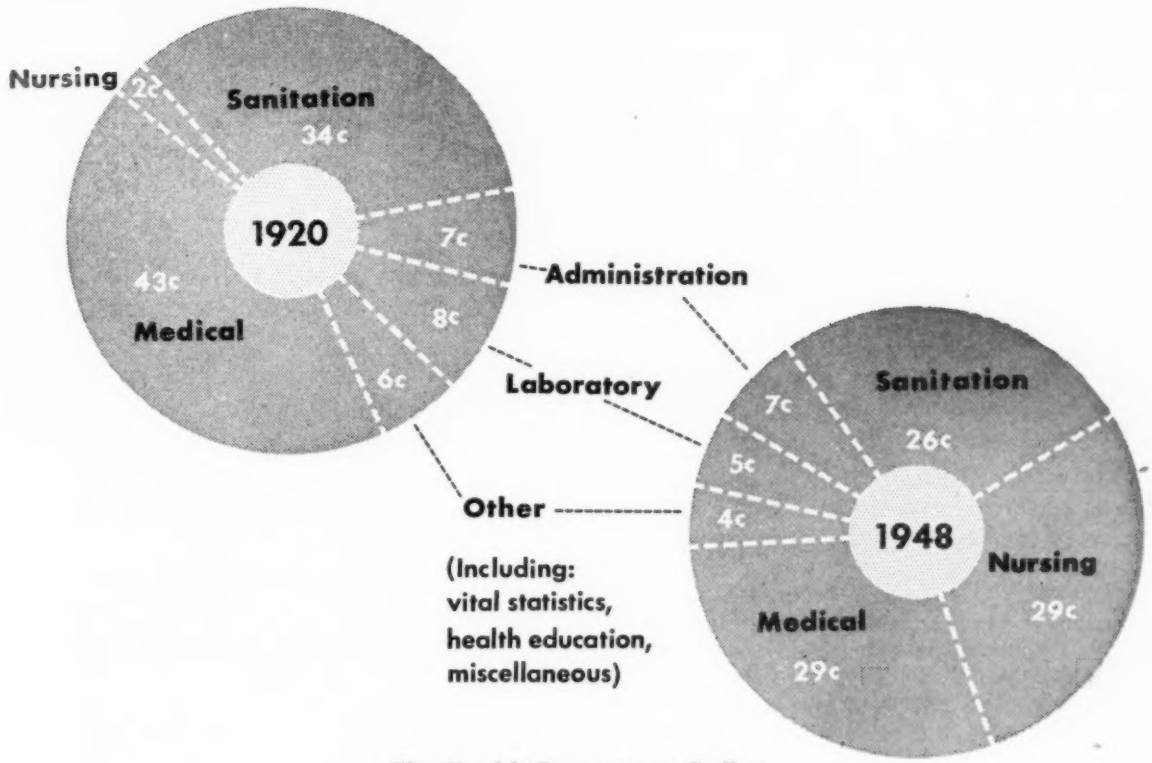
control, dental health, and mental hygiene, showed considerable variability and were not found in all cities.

There was considerable variation among the cities in the distribution of expenditures by service (tables 6 and 7). Nursing expenditures varied from 21 to 34 percent; the range for sanitation was from 18 to 41 percent; laboratory, from 3 to 12 percent; tuberculosis, from 4 to 12 percent; and venereal disease, from 2 to 9

Table 7. Per capita health department expenditures by service in 11 large cities, 1948

Service	Baltimore	Boston	Buffalo	Cleveland [1]	Detroit	Milwaukee	New Orleans	Philadelphia	Pittsburgh [1]	St. Louis [1]	Washington
All services	$1. 53	$1. 60	$1. 74	$1. 26	$1. 13	$1. 66	$1. 04	$0. 98	$1. 54	$1. 64	$2. 40
Administration	. 11	. 12	. 12	(2)	. 10	. 06	. 13	. 02	. 06	. 03	. 17
Health education	. 02	------	. 02	(2)	. 02	. 02	. 05	------	------	------	. 01
Vital statistics	. 09	. 02	. 03	. 07	. 03	. 04	. 07	. 02	. 01	. 06	. 04
Laboratory	. 12	. 05	. 22	. 06	. 06	. 08	------	. 07	. 05	. 11	. 12
Sanitation	. 39	. 39	. 41	. 36	. 30	. 43	. 23	. 26	. 46	. 67	. 44
Medical and nursing	. 79	1. 02	. 94	. 78	. 63	1. 03	. 56	. 60	. 96	. 76	1. 62
Nursing	. 46	. 38	. 52	. 43	(2)	. 54	. 28	(2)	. 43	(2)	. 50
Medical	. 33	. 64	. 42	. 35	(2)	. 49	. 28	(2)	. 53	(2)	1. 12
Communicable disease	. 03	. 07	. 03	(2)	(2)	. 08	. 03	(2)	. 08	(2)	. 07
Tuberculosis	. 10	. 20	. 11	(2)	(2)	. 09	. 05	(2)	. 07	(2)	. 23
Venereal disease	. 12	------	. 03	(2)	(2)	. 05	. 08	(2)	. 09	(2)	. 21
Cancer	------	------	(3)	(2)	(2);	------	------	(2)	------	(2)	. 02
Maternal, child	. 07	[4] . 18	. 04	(2)	(2)	[4] . 06	. 08	(2)	[5] . 06	(2)	. 27
School	. 01	(5)	. 13	(2)	(2)	. 07	(3)	(2)	[5] . 22	(2)	. 12
Mental	------	------	------	(2)	(2)	------	------	(2)	------	(2)	. 05
Dental	(3)	(6)	. 06	(2)	(2)	. 05	. 02	(2)	------	(2)	. 16
Other classification	(3)	. 19	------	(2)	(2)	. 09	. 01	(2)	------	(2)	------

[1] Expenditures for 1949. [2] Data not available. [3] Less than 1 cent. [4] Child hygiene only.
[5] Estimated figure. [6] Included under other classification.



The Health Department Dollar

percent. Whether these differences are accounted for by variations in the scope of program, in the volume of service rendered, or in the unit cost of providing the service could not be ascertained. Studies to determine the reasons for such wide variations should prove enlightening.

The Trend of Expenditures

A study of municipal health department expenditures was undertaken by the American Public Health Association in 1921 covering 83 cities with populations over 100,000 (*5, 6*). In 1923 the United States Public Health Service surveyed the 100 largest cities (*7*). Later, data on expenditures of health departments were available from reports on the Health Conservation Contests (*8, 9*). From these studies some trends can be observed. Average per capita expenditures of the health departments studied increased over 200 percent between 1920 and 1948, rising from $0.48 to $1.54 (table 5). The total medical-nursing cost increased from 22 to 79 cents per capita, the nursing cost alone from 1 to 44 cents. Expenditures for communicable disease were 8 and 7 cents per capita in the 2 years. Tuberculosis cost increased from 2 to 10 cents; venereal disease, from 1 to 8 cents. Sanitation expenditures increased from 16 to 39 cents per capita. The cost of administration increased from 3 to 10 cents per capita.

The medical-nursing programs are the most expensive in the public health field and have shown sharp rises in cost. The newer programs being undertaken by public health agencies, such as cancer and other chronic disease control, fall within this field. The implications for financing these added services cannot be ignored.

Significant shifts in program emphasis can be observed from an analysis of changes in the percentage distribution of health department expenditures by field of service. The total medical-nursing program cost increased from 46 to 61 percent of the health department budget. Nursing services are, of course, an aspect of the service programs in communicable disease control, maternal and child health, and other medical activities. Nevertheless, in many

cities, the nursing administration is centralized and is allotted a separate budget. For the eight cities where such a budgetary procedure was followed, the median expenditure for nursing in 1948 was 29 percent of the total health department budget. The corresponding figure as tabulated in 1920 was 2 percent. To what extent this represents a real difference in program or a difference in budget procedure is uncertain. Sanitation expenditures decreased from 34 percent in 1920 to 26 percent in 1948. Communicable disease control, not including special programs for tuberculosis and venereal disease, required 17 percent of all expenditures in 1920 and 3 percent in 1948. Tuberculosis and venereal disease programs changed from 4 and 2 to 6 percent each.

Discussion

The problems of persuading appropriating bodies to provide adequate funds for essential health services have received inadequate study. This is true for both aspects of the problem, namely, development of technical data which can be used to support budget requests and the processes required to inform budget officers and lawmakers. As the shortcomings in the data reviewed in this paper demonstrate, there is a lack of uniformity and completeness in the treatment of health department expenditure figures. Quantified evidences of monetary needs are meager. For example, discussions of the unit cost of providing specified public health services are all too rare. The business man, as Sabin (*10*) suggested, seeks a clear demonstration of the economy of the preventive approach. Efforts of this kind are not urged as a substitute for appeals based on personal and human values, but such arguments unsupported by statistical evidence represent an inadequate approach to this important aspect of public health administration.

Summary

The median health department expenditure for traditional public health services in 11 large cities in 1948 was $1.54 per capita. Municipal funds appropriated for public health services bore a close relationship to health expenditures in previous years and to total municipal tax revenue. Health expenditures represented approximately 3 percent of total municipal operating costs, and were lower than the per capita expenditure for any other major municipal service except penal institutions and libraries.

Large city health departments derived a median of 92.4 percent of their available funds from local governments, and 7.6 percent from Federal grants.

Medical-nursing services required 61 percent of the health department budget, nursing alone amounting to 29 percent. Sanitation functions required 26 percent; laboratory services, 5 percent; administration, vital statistics, and health education together, 10 percent. These proportions showed significant differences from the distribution in 1920, when medical-nursing services represented 46 percent, nursing alone 2 percent, sanitation 34 percent, and laboratory 8 percent.

REFERENCES

(1) U. S. Bureau of the Census: Large-city finances in 1948. Washington 25, D. C., U. S. Government Printing Office, 1949.

(2) Emerson, Haven, and Luginbuhl, Martha: Local health units for the Nation. New York, The Commonwealth Fund, 1945.

(3) Boyd, Richard F.: Essentials of good local public health administration. Am. J. Pub. Health **38:** 219–220 (1948).

(4) Community Chests and Councils of America: Expenditures for community health and welfare, 31 urban areas, 1948.

(5) First report of the committee on municipal health department practice of the American Public Health Association, November 1921. Am. J. Pub. Health **12:** 7–15; 138–147 (1922).

(6) Expenditures of health departments. Am. J. Pub. Health **13:** 441–458 (1923).

(7) Freeman, Allen W.: The cost of public health work. Am. J. Pub. Health **15:** 1046–1050 (1925).

(8) Mountin, Joseph W.: Specific expenditures and personnel of official health agencies in certain cities. Am. J. Pub. Health **25:** 545–550 (1935).

(9) Expenditures in certain cities for selected health services. Am. J. Pub. Health **26:** 1008–1013 (1936).

(10) Sabin, Florence R.: The ailments of health departments. Am. J. Pub. Health **38:** 1508–1511 (1948).

The Basis of Communicable Disease Control

By WILSON G. SMILLIE, M.D., Sc.D., Dr.P.H.

Any public health measure we employ has a background of tradition and precedent. Some of these traditions have outlived their usefulness and have been abandoned; others have been modified to meet (or to resist) changing conditions and have become firmly embedded in our public health structure.

Let us review briefly the historical aspects of the reporting of communicable disease in this Nation in order to understand why and how we have built our present system.

An axiom that was established very early in our national history was: **Before a community can do anything to prevent the spread of communicable disease, it must be aware of the existence of the disease.**

The colony of Rhode Island recognized this principle as early as 1741, when it passed an act requiring tavern keepers to report contagious disease that occurred among their patrons. In 1743, this same colony instituted a law which formulated the present-day principles of communicable disease reporting. Diseases to be reported to the local authorities were smallpox, yellow fever, and cholera. Typhus was added later. The early reports were made to the mayor or town clerk. This general plan was adopted throughout the Colonies. When local boards of health were formed, beginning in 1792, the reports were made directly to the chairman of the board.

The first State law that relates to disease reporting that I have found is cited in "The History of Quarantine in Louisiana," by Joseph Jones (*1*). A Louisiana State law was passed in 1821 requiring all inn keepers, tavern keepers, and boardinghouse keepers to report the names of any sick persons in their establishments to the local board of health within 12 hours. This regulation applied to the period of May 1 to October 1. All physicians having a patient sick with yellow fever, or bilious malignant fever, or pestilential fever had to report this circumstance to the board of health in writing within 24 hours. The law applied to the period May 1 to November 1. The purpose of this law was, of course, to detect, as early as possible, the presence of yellow fever.

The principle established in those early days was that the diseases to be reported must be pestilential, that is to say, they must be epidemic, virulent, and contagious.

Throughout the nineteenth century, the major pestilential diseases were considered to be smallpox, cholera, and yellow fever. Only during the latter part of the century was the notification of the more common communicable diseases required. In 1901, only a half century ago, Chapin (*2*) made a nation-wide summary of laws relating to the reporting of communicable diseases. He states that all State and municipal notification laws mentioned smallpox, and most included cholera. Diphtheria, membranous croup, scarlet fever, and yellow fever were specifically recognized as reportable in 11 States

---

Dr. Smillie is head of the department of public health and preventive medicine, Cornell University Medical College, New York, N. Y. *He presented this paper before the Conference of State Epidemiologists on National Morbidity Reporting sponsored by the Communicable Disease Center and the National Office of Vital Statistics, Public Health Service, Atlanta, Ga., April 18–20, 1951.*

only. Typhus fever was reportable in nine States; typhoid fever, in seven. This latter disease was reportable also in a few cities. Measles and whooping cough were reportable in only a very few cities and in no States. Tuberculosis was reportable in two States in 1901. Syphilis and other venereal diseases were not reported at all. Pneumonia was reportable only in Hartford, Conn.; malaria, in Oakland, Calif.; and hydrophobia, in Ohio only. Thus our present administrative procedures and complicated reporting systems have developed during this past 50 years.

Original Purpose of Required Reporting

The primary purpose was to determine, as early as possible, the presence in the community of "diseases dangerous to the public health." This was done in order to institute, as rapidly as possible, isolation procedures for the individual and quarantine of the family household, the infected arriving ship, or even the quarantine of a whole community.

As early as 1743, a Charleston regulation required reporting by the incoming ship's captain to the pilot of the port of any illness aboard. At first the infected vessels were quarantined in the roadstead until everyone died or recovered. A few years later, Charleston was the first American community to establish a pesthouse on land.

Quite logically, during most of the nineteenth century, no reporting was required of tuberculosis, pneumonia, infantile diarrhea, malaria, typhoid fever, nor any other of the common infections, since these were believed to be due to environmental factors such as poisoned air, decaying vegetables or animals, bad smells, or perhaps telluric influence. Thus, isolation and quarantine were thought to be of no value in checking these diseases. At this time, as we have noted, the only diseases to be reported were smallpox, yellow fever, and cholera. They were reported because they were epidemic, virulent, and obviously contagious diseases that were dangerous to the public health, and against which active protective measures might be taken.

This broad general urgency to check pestilence is still our primary motive in requiring the reporting of communicable disease.

New Concepts in Disease Reporting

As the science of epidemiology developed and more and more information was obtained about the general principles of the etiology and mode of spread of contagion, we began to desire more accurate and detailed epidemiological information concerning all communicable diseases. Thus, there grew up rapidly a long list of diseases which the health department insisted must be reported. Physicians resented this intrusion on their time, and objected strenuously to revealing personal (often confidential) matters relating to their private patients. This resentment has continued through the years, particularly when the physician could not see that anything would be gained—either of direct benefit to the community or to his patient—from these reports. It is common knowledge that many private patients insisted that their physicians should not report their diseases to the authorities. This was particularly true in the case of tuberculosis and venereal disease, as well as other conditions that bore a social stigma.

Thus, although the States and local health departments built up elaborate plans for the reporting of an all-inclusive list of communicable diseases, only a relatively few of these diseases have ever been reported adequately (by "adequately" I mean 90-percent completeness). There is now good reason to believe that the disinclination of physicians to report certain communicable diseases will increase rather than decrease. They see no particular need for reporting gonorrhea at the present time, since the patient will be cured before the report reaches the office of the health department. Why report lobar pneumonia, queries the physician, when the health department has no measures of prevention, no specific diagnostic tests are required, and therapy is so effective?

It is clear that the physicians of the next decade will pay little attention to the regulations relating to reporting. Most doctors will report promptly a case of communicable disease that may require hospitalization, a diagnostic facility, or a follow-up service. But when notification of a disease is regarded as a simple formality, without apparent direct benefit to the patient, to his family, or to the community,

the procedure of reporting will often be neglected.

If we are realistic, we know that the physician looks at epidemiologists with a quizzical eye and asks a very pertinent question:

"What is your purpose in requiring me to notify you of the existence of a case of communicable disease? What is to be gained thereby? The changes in the natural history of disease, coupled with social and medical growth, have made these procedures unnecessary. The improvement in community and personal hygiene, the development of new methods of control, the advancement in procedures for more accurate and more rapid diagnosis, and the almost explosive increase of specific therapy have made obsolete this practice of reporting communicable disease to the health department."

Your answer may be that the purpose of notification is to enable the health officer to institute measures that will prevent further spread of serious infection. Thus, the primary object is the rapid and complete reporting of diseases of high infectivity and a high degree of fatality.

In the past, this was a perfectly reasonable demand. Yellow fever, typhoid fever, smallpox, cholera, diphtheria, and scarlet fever all fell in this general category and all were well reported. In each of these diseases, definite control measures became available which were effective and most satisfactory, both from the point of view of the patient and the community.

But the practitioner, who is the source of almost all our information in early discovery of communicable diseases, will promptly point out that the diseases which we have mentioned, including malaria and most of the rickettsial diseases as well, no longer appear in our mortality tables. Actually, they are well under control.

Recently, the Chief Medical Officer of Scotland (*3*)[1] emphasized that, at the present time, the major communicable diseases that are dangerous to the public health are such epidemic conditions as food poisoning, influenza, poliomyelitis, infantile diarrhea, etc. He notes that, in these conditions, notification will not prevent further spread, since known defensive measures have proved of little avail, and our major recourse, therefore, is the prevention of the original occurrence of the disease.

What then is our purpose in requiring the reporting of communicable disease? Are these procedures obsolete?

Essential for Epidemiological Knowledge

Despite this reasonable objection of physicians, we adhere firmly to the philosophy that there is a very sound fundamental reason for required reporting of communicable disease. We realize that this procedure is no longer of great benefit to the sick individual, nor perhaps to his family. But we do believe that the plan is of great community benefit.

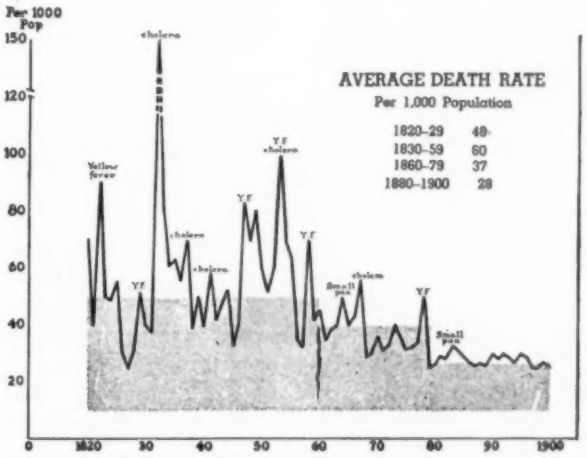


Figure 1. Crude death rate per 1,000 population for New Orleans, 1820–1900.

The graph of the death rate of New Orleans 1820–1900 (fig. 1) illustrates the point that yellow fever, smallpox, and cholera were considered the pestilential and, thus, the reportable diseases of the last century.

The peaks of the graph were produced by these three diseases. But the great mass of unnecessary deaths (see shaded areas) were due to "natural causes" and were taken as a matter of course, and as a part of normal expectancy in life. The major causes producing these deaths were diarrheal diseases of infants, tuberculosis, communicable diseases of childhood, and water-borne infections. None of these dis-

[1] The author is indebted to this article for many of the ideas presented in this paper.

eases were reportable until comparatively recent years, beginning about 1900.

Philadelphia has had a better health record than almost any of our large cities. But in 1794 it had the greatest disaster, in proportion

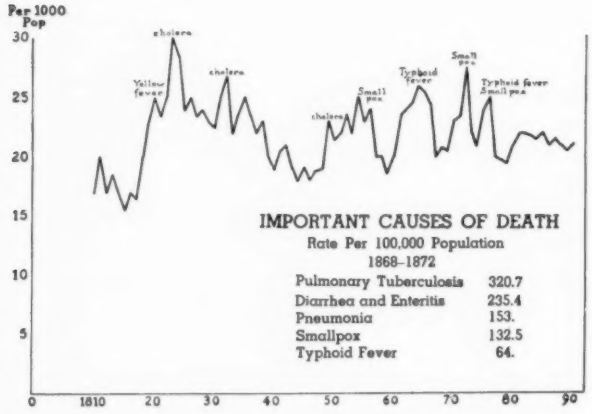


Figure 2. Crude death rate per 1,000 population for Philadelphia, 1810–90.

to the population, that any American city ever suffered. This was the yellow fever epidemic which caused over 4,000 deaths in some 35,000 population. As figure 2 shows, cholera and smallpox were considered the greatest menaces to Philadelphia. But in 1868–72 the tuberculosis death rate was 320.7 per 100,000 population, and the death rate from diarrhea and enteritis was 235.4. Neither of these conditions was reportable because neither was considered pestilential.

The great peaks in the mortality curves disappeared in all areas in the Nation about 1900. The only exception during the past 50 years has been the relatively small peak caused by the influenza epidemic in 1918.

A completely different reason for reporting communicable disease was developed during the twentieth century, beginning about 1900. The major purpose was to elucidate the natural history of the disease "in distinct epochs of time at varying points on the earth's surface" (Frost's definition). The accumulation of these invaluable data for poliomyelitis is illustrated by figures 3, 4, and 5. These data are not mortality, but morbidity data; not deaths from a disease, but its prevalence. They can be obtained only by accurate and complete reporting. These graphs bring out the point that the primary purpose of disease reporting at the present time is to enable the epidemiologist to study the natural history of disease. Some of the results

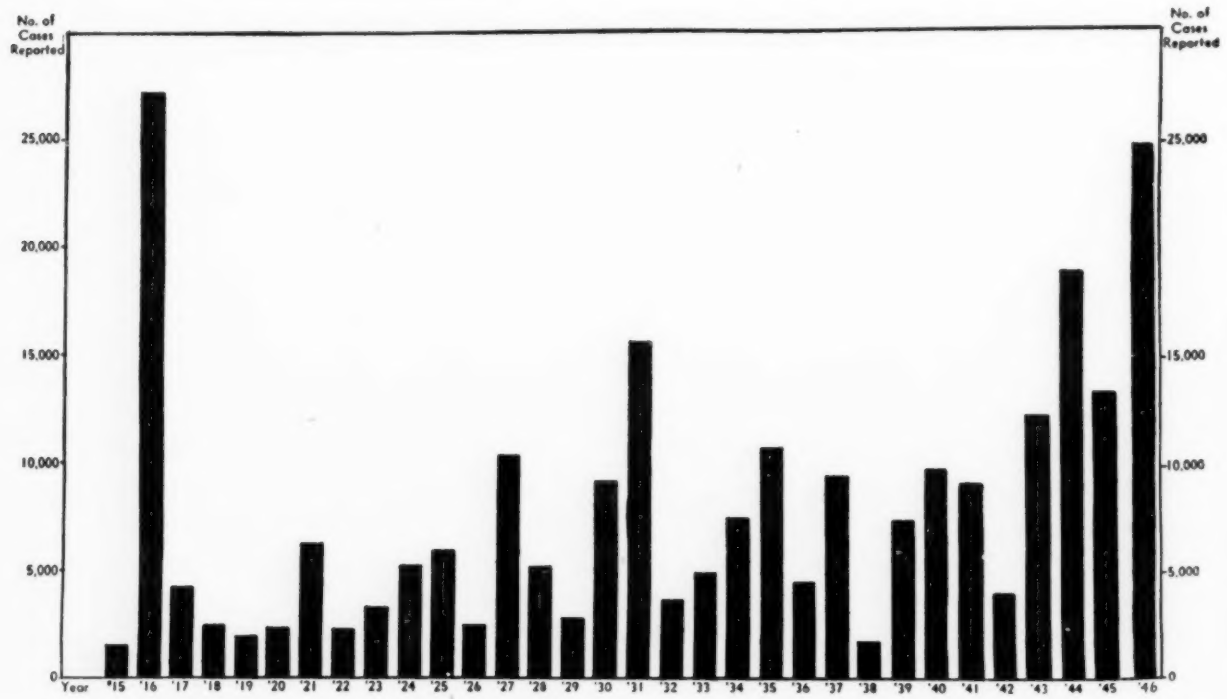


Figure 3. Poliomyelitis cases reported in the United States, 1915–46.

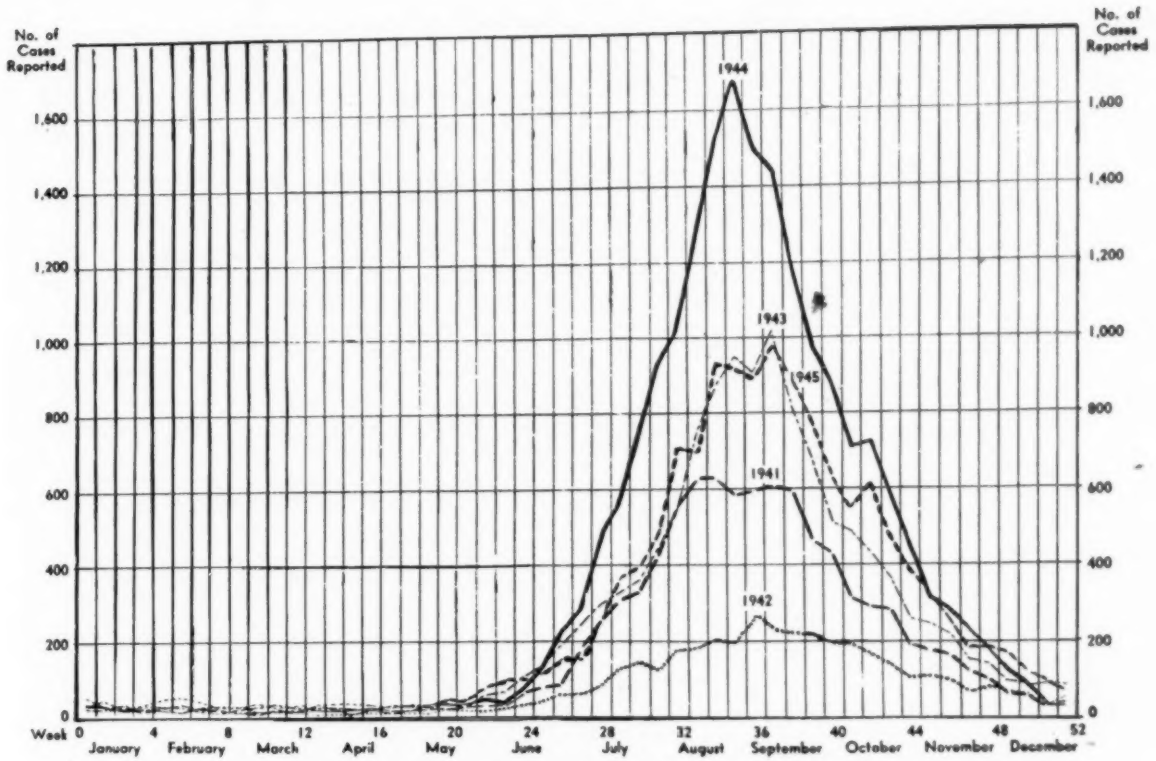


Figure 4. Weekly incidence of poliomyelitis in the United States, 1941–45.

that will be obtained by careful communicable disease reporting may be cited:

1. An analysis of the trends of the prevalence of the disease.
2. Its distribution in various age groups, its sex preference, and its appearance in social groups and in groups of varying economic status.
3. The geographic distribution of the disease and its geographic variations through the years.
4. The seasonal distribution of the disease under study and its correlation with other readily measurable environmental factors.
5. Changes in case fatality ratio.
6. Changes in actual virulence of the infection.
7. The benefits of new methods of therapy in reducing: (*a*) severity of the illness; (*b*) period of hospitalization; (*c*) risk of secondary attacks; and (*d*) incidence of carriers.

These and many more are the epidemiological reasons that give us complete justification for

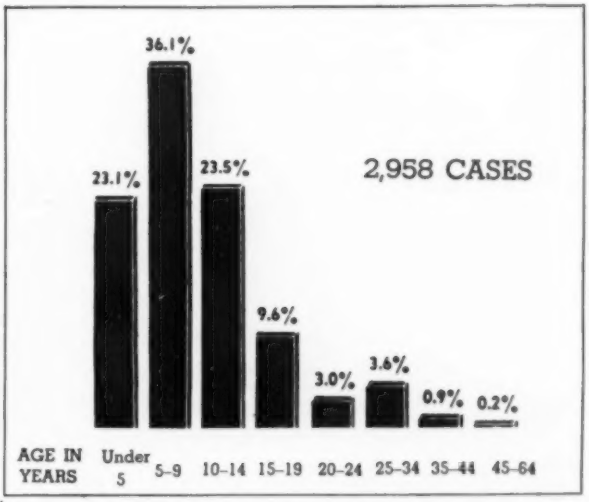


Figure 5. Percentage distribution of poliomyelitis cases by age in Chicago and Detroit, 1939–44.

the regulations requiring reporting of communicable disease. In summary, let us return once more to Frost's definition of epidemiology: "It is the science which considers the distribution, occurrence, and types of diseases of mankind in distinct epochs of time at varying points on the earth's surface, and will provide an account of the relations of these diseases to in-

herent characteristics of the individual and to the external conditions surrounding him and determining his manner of life."

Conclusion

Only through a satisfactory, accurate, prompt system of disease reporting can the science of epidemiology be implemented. It is the cornerstone of the whole structure of the science.

REFERENCES

(1) Jones, Joseph: The history of quarantine in Louisiana. *In* his medical and surgical memoirs, New Orleans, 1890, vol. III, part I, pp. CXIV–CLXXIII.

(2) Chapin, Charles: Municipal sanitation in the United States. Providence, R. I., Snow and Farnham, 1901, 970 pp.

(3) Health Bulletin of the Chief Medical Officer of Scotland. Notification of infectious diseases. October 1950.

Sale of Dangerous Drugs Restricted by New Law

Drugs which may be dispensed only upon a physician's prescription are now clearly defined by a Federal law, the Durham-Humphrey amendment to the Federal Food, Drug, and Cosmetic Act, which will become effective April 26, 1952. After that date drug manufacturers will be required to label all such drugs with the legend: "Caution: Federal law prohibits dispensing without prescription." Thus, retail pharmacists will be able to tell immediately from the package whether or not a drug is one which requires a prescription.

The new law restricts to prescription sale any drug which "because of its toxicity or other potentiality for harmful effect, or the method of its use, or the collateral measures necessary to its use, is not safe for use except under the supervision of a practitioner licensed by law to administer such drug." The Food and Drug Administration interprets this definition to include, as unsafe, drugs for serious diseases which cannot be treated effectively by the layman. An example of such a drug would be penicillin, which is nontoxic but which requires expert medical knowledge for effective use in treating certain diseases, such as pneumonia.

Under the new bill, prescriptions for drugs which bear the "Caution" label may not be refilled without specific authorization of the prescribing physician. However, drugs which do not require a prescription for the first sale may be sold across the counter in the original package, or as a refill of a prescription without further authorization by the physician.

The new law legalizes telephoned prescriptions for all drugs. Such prescriptions for restricted drugs, however, must be put promptly in writing and filed by the pharmacist.

This legislation will strengthen control over the sale of such drugs as barbiturates, amphetamines, sulfa drugs and antibiotics, thyroid, and male and female sex hormones.

The ethics of the pharmaceutical profession have always required that dangerous drugs be dispensed and prescriptions for them be refilled only on instructions from the physician. The new law makes it legally mandatory for all druggists to follow these practices.

Units of Radiation and Radioactivity

By ELDA E. ANDERSON, Ph.D.

Measurements, and the units in which the measurements are to be made, are important in any discussion of a scientific subject. We begin to know something about a physical quantity when we can measure it. If we are to assess the hazards associated with radioactivity, if we are to use the radiations for therapy, for biological research, and in industry, we must be able to measure the strength of our radioactive source, we must be able to measure the radiation dose received; and to do so, we must have units in which to make the measurements.

As in any growing and expanding science in which our knowledge is still limited, agreement on measurements made in different laboratories is not perfect, and as yet agreement on terminology and in the magnitudes of all units has not been reached. Some confusion results, but we can reduce such confusion by a knowledge of, and exactness in, the terms used.

Curie

Let us turn first to units for measuring the activity of a radioactive source. Determination of the absolute activity of radioactive samples is highly important in dose determinations and is based on the number of atoms disintegrating per second. Conventionally, the unit of activity or quantity of radioactive material is the curie. When the principal radioactive element in general use was radium, there were two well-defined units for expressing the quantity of radioactive material. One was simply a gram of radium, which could be determined by weighing. Amounts of radium were then determined by comparing the gamma radiation of the unknown sample with that of a carefully weighed standard, when conditions of filtration, instrument for measuring the radiation, and geometry all were the same.

Since in many cases radon is used in place of radium, a second unit named the curie was defined as that quantity of radon (0.66 $mm.^3$ at 0° and 760 mm. Hg) in radioactive equilibrium with 1 gram of radium. In 1930, the curie was extended to include the equilibrium quantity of any decay product of radium—that quantity of a decay product of radium which has the same disintegration rate as a gram of radium, or that has the same number of atoms disintegrating per unit time as 1 gram of radium. Measurements of the absolute decay rate of radium are not in perfect agreement; hence, the number is not precisely known, and in 1930 the International Radium Standard Commission recommended using the value of 3.7×10^{10} disintegrations per second. (A millicurie corresponds to 3.7×10^{7} dis/sec.; 1 microcurie, to 3.7×10^{4} dis/sec.)

The curie has become widely adopted as a measure of the quantity of any radioisotope and not limited to members of the radium family as recommended by the commission. Thus, 1 mil-

---

Dr. Anderson, chief of education and training in the Health Physics Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn., presented this paper at the inservice training course in Radiological Health at the School of Public Health, University of Michigan, Ann Arbor, in February 1951. It is reproduced by permission from the published lectures as background material for Dr. Straub's report on Radioactive Materials and Their Effects on Environmental Health, page 298.

licurie of P^{32}, Na^{24}, or C^{14} means the amount of the isotope necessary to provide disintegrations at the rate of 3.7×10^7 atoms per second. Failure to distinguish between total ionizing events and total disintegrations in the case of isotopes that do not have simple decay schemes has led to confusion and error in the use of the curie. For example, with a radioisotope that emits both a beta ray and a gamma ray in each disintegration, if there are internal conversion electrons, measurement of the beta particles will lead to a too-high disintegration rate. If only the gammas are measured, a too-low disintegration rate results. Unless the number of gammas leading to conversion electrons is known, the disintegration rate will not be correct and the amount of the radioactive isotopes expressed in curies will be incorrect.

Likewise, consider the error which could arise in measuring the activity of $Mn,^{52}$ which has a half-life of 6.5 days and decays by positron emission in 35 percent of the transitions and by electron capture in 65 percent of the transitions. One millicurie of Mn^{52} emits only $0.35\times3.7\times10^7$ or 1.3×10^7 positrons per second, even though there are 3.7×10^7 disintegrations per second.

The use of the curie to describe any radioactive source which produces the same gamma ray response as 1 curie of radon is another serious misuse of the curie unit. The objection is that the gamma ray response depends on the detection instrument used. For example, the ratio of the apparent gamma ray intensity of a source of 8-day I^{131} to a source of radon is four times as great if measured with a platinum cathode counter as when measured with a copper cathode counter. The curie should be used strictly to mean that quantity of radioactive material which has 3.7×10^{10} atoms disintegrating per second.

Rutherford

Since there is a discrepancy between the number of disintegrations per second from 1 gram of radium and the number adopted by international agreement, Curtis and Condon proposed a new unit for radioactivity, the Rutherford, defined as that quantity of a radioisotope decaying at a rate of 10^6 disintegrations per second. However, this unit has not come into widespread use. The unit used to compare source strengths is the roentgen-per-hour-at-unit-distance, which we shall define after discussing the roentgen.

Dose Units

Roentgen

A unit of radiation dose should be readily reproducible and should be measurable in terms of simple physical quantities by routine instrumentation. In most cases the ultimate information desired is the biological damage produced by a given dose of radiation; hence, it would be desirable to have our unit of radiation dose proportional to the biological damage produced. However, the factors involved in radiation damage are so complex and so little known that it has not been possible to devise a unit having both these physical and biological characteristics. The physical quantity selected must be capable of being measured with reasonable accuracy and of being expressed in absolute units. Thus, the unit of dose may be either the energy absorbed from the radiation per unit mass or the ionization produced per unit of mass.

If we select as our physical quantity the energy absorbed per unit mass of tissue, we may measure the energy in ergs or multiples of ergs, i. e., joules (1 joule is 10,000,000 ergs). In recent years another energy unit has come into widespread use because of its convenience, the electron volt, which is defined as the energy an electron acquires in falling through a potential difference of 1 volt. Frequently used is the unit Mev, which is 1 million electron volts, or that energy which an electron would acquire in falling through a potential difference of 10^6 volts. Today, particles with energies of many Mev are commonplace. Since both ergs and electron volts measure the same quantity, they must be numerically related, and therefore, we find that 1.6×10^{-12} ergs is equivalent to 1 electron volt (e. v.) or 6.2×10^{11} e. v.$=1$ erg.

If our unit of dose is the ionization per unit mass produced by the radiation, we would measure it in terms of the number of charges formed per unit mass. The unit of charge we shall use is the electrostatic unit. Whichever unit of

dose is employed, energy absorbed per unit mass or ionization per unit mass, the ionization produced per unit volume is the physical quantity actually measured.

The roentgen is that "quantity of X- or gamma-radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, ions carrying 1 esu [electrostatic unit] of quantity of electricity of either sign (*2*)." The quantity of air referred to is 1 cc. of dry air at 0° C. and 760 mm. Hg. The roentgen (r.) is a unit of radiation exposure and is based on the effect of X or gamma radiation on the air through which it passes and applies only to X or gamma radiation in air. The unit considers the ionization caused by the secondary particles (electrons) ejected from some known volume of air (1 cc. at standard conditions). The ionized tracks of these particles may go outside of the known volume, but it is important that their total ionization be collected wherever it occurs.

The roentgen is not a radiation unit. It does not describe the number of photons in the beam nor their energy; it merely gives the effect of that radiation in 1 cc. of air. Part of the energy of the radiation is given to the air in producing photoelectrons, Compton electrons or in pair production, and these secondary particles in turn produce other electrons and positive ions. When all ions of either sign are counted and are found to be 1 esu, then 1 roentgen of X or gamma radiation has been absorbed by the original volume of air. Since the charge on 1 electron is 4.8×10^{-10} esu (electrostatic units), the 1 esu of charge represents $\frac{1}{4.8\times10^{-10}}$ or 2.083×10^{9} electrons. This is also the number of ion pairs per esu, since only one partner of the ion pair is measured. Thus, the roentgen may be defined as that quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, 2.083×10^{9} ion pairs, or 1.61×10^{12} ion pairs per gm. of air. Since the energy required to form an ion pair in air is 32.5 e. v., the roentgen represents energy absorption of 6.77×10^{4} Mev/cc. of air, or 5.24×10^{7} Mev per gm. of air, or 5.24×10^{13} e. v.$\times1.60\times10^{-42}$ ergs/e. v.$=83.8$ ergs/gm. of air.

Thus 1 roentgen of X or gamma rays is that quantity of radiation in which approximately 83.8 ergs are absorbed per gram of air. Thus, according to the official 1937 definition, a dose of 1 roentgen received at any point means:

1 esu of ion pairs produced per cc. of air.
2.083×10^{9} ion pairs produced per cc. of air.
1.61×10^{12} ion pairs produced per gm. of air.
6.77×10^{4} Mev absorbed per cc. of air.
5.24×10^{7} Mev absorbed per gm. of air.
83.8 ergs absorbed per gm. of air.

One roentgen of X or gamma rays is that quantity of radiation whereby 83.8 ergs are absorbed per gram of air, but in substances of different atomic number and different density the amount of energy absorbed per unit volume for the same quantity of radiation will be different. In soft tissue the energy absorbed per gram of tissue per roentgen is approximately 93 ergs, while in bone it may be higher. Although the relative amounts of energy absorbed in different substances show wide variation, the dose is still 1 roentgen if the same quantity of radiation produces 1 esu of charge of either sign per 0.001293 gram of air at the point under consideration. The dose expressed in roentgens is totally independent of the absorbing medium exposed to the radiation and of the amount of energy that the particular medium absorbs. Nor does the roentgen depend on the time required for the production of the ionization; as long as 1 esu of charge of either sign is produced in 1 cc. of standard air, the dose delivered is 1 roentgen regardless of whether it took 1 second or 1 hour to produce the 1 esu. Consequently, dosage rates are given in roentgens per hour. For example, if a constant dosage rate of 2 roentgens per hour is continued for 5 hours, the total dose delivered is 10 roentgens, and in the 1 cc. of standard air 10 esu of charge is produced.

Since the definition of the roentgen requires that the total ionization produced by the secondary electrons formed per cubic centimeter of standard air be measured, and as some of the secondary electrons may have ranges of several meters, large and cumbersome apparatus would be needed. To avoid such large unwieldy apparatus, "air wall" roentgen chambers or "thimble chambers" have been developed. Their use is based on the principle that, when a tiny cavity such as a small ionization chamber is placed in a large homogeneous absorbing medium which is

uniformly irradiated, the atmosphere of secondary electrons in the cavity is identical in every respect with the electron atmosphere which existed in the medium before the cavity was introduced. If the chamber gas is air, and if the walls are composed of materials having an atomic number near that of air, the ionization per gram of air in the chamber will be substantially the same as the gamma-ray energy loss per gram of air at the point where the chamber is located.

Roentgen-Equivalent-Physical

The roentgen applies only to X-ray and gamma radiation; however, ionization in tissue is often produced by radiations other than photons, that is, by betas, alphas, neutrons, and protons. Thus, there is need for a dose unit applicable to corpuscular radiation, which will be a measure of the energy absorbed in tissue exposed to these radiations. The roentgen-equivalent-physical (rep), introduced by H. M. Parker, is defined as that dose of any ionizing radiation which produces energy absorption of 83 ergs per gram of tissue. Thus, if the energy loss by ionization in the tissue is the same as the energy loss for 1 roentgen of gamma radiation absorbed in air, the dose is referred to as 1 rep. The name implies physical equivalence with the roentgen, but in general such equivalence does not exist, for the rep is not equal to the energy absorbed per gram of tissue exposed to 1 roentgen. The energy absorbed in tissue exposed to gamma radiation depends on atomic composition and density of the tissue as well as on the energy of the photons, whereas a rep is always 83 ergs per gram of tissue independent of kind of tissue or the energy and type of the corpuscular radiation. In soft tissue, a dose of 1 roentgen corresponds to the absorption of approximately 93 ergs per gram. There has been considerable discussion in favor of changing the rep to 93 ergs per gram of tissue, and some persons prefer the use of 95 or 100 ergs per gram.

Roentgen-Equivalent-Man

The biological evidence indicates that the effects of the various ionizing radiations are not the same and that a different degree of tissue damage can be expected from the absorption of 100 ergs of alpha-ray energy than from 100 ergs of beta-ray energy or from 100 ergs of neutron energy. The roentgen-equivalent-man (rem) is that dose of any ionizing radiation which, delivered to man, is biologically equivalent to the dose of 1 roentgen of X or gamma radiation. The rem is not a measure of energy absorption or of ionization produced in tissue, but is rather a measure of a quantity of radiation that produces certain observed biological effects. Extensive experimental studies have been made of the relative biological effectiveness (RBE) of the ionization produced in tissue by the various types of ionizing radiations and an equal amount of tissue ionization due to gamma rays. The values obtained for the various radiations show rather wide variations with effects (blood counts, median lethal dose) and with different species of mammals. Present accepted RBE values are:

Beta rays	1
Protons	10
Alpha rays	20
Fast neutrons	10
Thermal neutrons	5

In terms of energy, 1 rem $= \frac{95}{\text{RBE}}$ ergs/gm. tissue or, in terms of the rep, 1 rem $= \frac{\text{rep}}{\text{RBE}}$. Thus, for alphas, 1 rem $= \frac{95}{20}$ ergs/gm. tissue; 1 rem $= \frac{1}{20}$ rep $= 0.05$ rep.

The maximum permissible tissue dose for X-rays and gammas is 0.3 rep per week, while for alphas it is 0.015 rep per week, and for fast neutrons, 0.03 rep per week; or, expressed in rem per week, for X and gammas 0.3 rem per week, for alphas 0.3 rem per week, for neutrons 0.3 rem per week. Since a rem of alphas produces the same biological damage as a rem of gammas or a rem of neutrons, doses expressed in rems are additive. Thus, an exposure to 100 millirem (mrem) of gammas and 200 mrem of neutrons is a total dose of 300 mrems.

Roentgen-Per-Hour-at-One Meter

Having defined the roentgen, we can now discuss the unit of radioactive source strength, the roentgen-per-hour-at-unit-distance. For a

particular radioactive substance which emits gamma rays, this unit provides a means of stating the amount of that substance without knowledge of its disintegration scheme. The roentgen-per-hour-at-one-meter (rhm) is that amount of a radioactive isotope whose unshielded gamma-ray emission produces 1 roentgen per hour in air at a distance 1 meter from the source. By use of a standard instrument reading in roentgens per hour, a standard technique, and the rhm, the source strength of various gamma-ray emitters can be compared and expressed in terms of the number of roentgens per unit of time, produced at some arbitrary distance. The unit has the advantage in that the disintegration scheme need not be known, whereas it must be known in order to express quantity of radioactive material in curies.

These then are the units used to express quantities of radioactive materials, the curie and the rhm; to express dose, the roentgen, the rep, and the rem. With these units it is possible to correlate the effects of radiation on living tissue with external measurements of the exposure, or with calculated internal doses.

REFERENCES

(*1*) Condon, E. U., and Curtiss, L. F.: New units for measurement of radioactivity. Physical Rev. 69: 672–673 (1946).

(*2*) U. S. Department of Commerce, National Bureau of Standards: Medical X-ray protection up to two-million volts. Handbook 41, March 30, 1949, p. 1.

Field Training Courses in Insect and Rodent Control

Field training courses in insect and rodent control will be offered during the months of March and April 1952 by the Public Health Service Communicable Disease Center, Atlanta, Ga.

The course in rodent control is scheduled for the period from March 17 to April 4. It is designed to give public health personnel a practical working knowledge of the control of domestic rodents and rodent-borne diseases. Field work, giving the trainee an opportunity to practice the principles developed in classroom lectures and discussions, will be emphasized.

A 2-week course in insect control will be held April 7–18. It will offer practical field training in the control of insects affecting the health and well-being of man. Emphasis will be placed upon the identification, biology, and control of flies, mosquitoes, and household and restaurant insects. Survey and control techniques will be demonstrated, and field practice in Atlanta and surrounding areas will be offered.

These courses are available to interested personnel from State and local health departments and the Public Health Service. Persons from other organizations concerned with insect and rodent control will also be accepted if facilities permit.

Applications should be made by letter through the sponsoring agency to: Officer in Charge, Communicable Disease Center, Public Health Service, 50 Seventh Street, NE., Atlanta 5, Ga. Attention: Chief, Training Branch.

Effect of Radioactive Materials On Environmental Health

By CONRAD P. STRAUB, Ph.D.

In a recent discussion relating to environmental health, Mark D. Hollis (*1*) indicated that public health officials will be responsible for protecting the population against the harmful effects of ionizing radiation. Ionizing radiations result from the disintegration of unstable nuclei and are damaging to living tissue. The radiation may originate from an external source or from radioactive materials within the body. Radiation from an external source may affect the body as a whole, if there is no shielding, or may be made to affect only certain portions of the body, as in radium treatment of a tumor. Effects of damage from radioactive materials within the body depend on several factors: the quantity of radioactive material present in the body; the type of radiation, whether alpha, beta, or gamma; and the half-life or rate of decay of the material. Other factors to be considered are the organ or organs of localization; rate of excretion from the body, i. e., the biological half-life; the physical state of the individual; etc. All of these factors are considered in determining the maximum permissible concentration (MPC) for each radioisotope in water or air. The MPC values under consideration for release by the Subcommittee on Internal Dose of the National Committee on Radiation Protection (*2*) are indicated in table 1.

Inasmuch as the Atomic Energy Commission

Dr. Straub is a sanitary engineer with the Public Health Service Environmental Health Center, on assignment to the Health Physics Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn. *This paper was presented at a meeting of the sanitation section of the Georgia Public Health Association in Savannah, May 7, 1951.*

Table 1. Tentative maximum permissible concentration for certain radioisotopes in water and air

Element	μc/cc. water	μc/cc. air
U Nat. (soluble)	8×10^{-5}	1.7×10^{-11}
U Nat. (insoluble)		1.7×10^{-11}
U^{233} (soluble)	1.5×10^{-4}	1×10^{-10}
U^{233} (insoluble)		1.6×10^{-11}
Ra^{226}	4×10^{-8}	8×10^{-12}
Rn^{222}	2×10^{-6}	1×10^{-8}
Pu^{239} (soluble)	1.5×10^{-6}	2×10^{-12}
Pu^{239} (insoluble)		2×10^{-12}
Po^{210} (soluble)	3×10^{-5}	2×10^{-10}
Po^{210} (insoluble)		7×10^{-11}
C^{14} (CO_2)	3×10^{-3}	5×10^{-7}
H^3	0.2	2×10^{-5}
Ca^{45}	5×10^{-4}	4×10^{-8}
P^{32}	2×10^{-4}	1×10^{-7}
K^{42}	1×10^{-2}	2×10^{-6}
S^{35}	5×10^{-3}	1×10^{-6}
Na^{24}	8×10^{-3}	2×10^{-6}
Cl^{36}	2×10^{-3}	4×10^{-7}
Fe^{55}	4×10^{-3}	6×10^{-7}
Fe^{59}	1×10^{-4}	1.5×10^{-8}
Mn^{56}	0.15	3×10^{-6}
Cu^{64}	8×10^{-2}	6×10^{-6}
I^{131}	3×10^{-5}	3×10^{-9}
Sr^{89}	7×10^{-5}	2×10^{-8}
$Sr^{90} + Y^{90}$	8×10^{-7}	2×10^{-10}
A^{41}	5×10^{-4}	5×10^{-7}
Xe^{133}	4×10^{-3}	5×10^{-6}
Xe^{135}	1×10^{-3}	2×10^{-6}
Co^{60}	2×10^{-2}	1×10^{-6}
Au^{198}	3×10^{-3}	1×10^{-7}
Au^{199}	7×10^{-3}	2.5×10^{-7}
Cr^{51}	0.5	8×10^{-5}
Ni^{59}	0.25	2×10^{-5}
Mo^{99}	14	2×10^{-3}

supervises the control and discharge of radioactive wastes from its own operations, State and local health officials are not directly concerned with the waste products which result from operations within AEC-controlled areas. Public health officials will be occupied with the discharge of wastes into the environment beyond the controlled area of operations, with the discharge into the sewerage system of radioisotopes from hospitals and research institutions, and with the industrial use of radioisotopes in manufacturing processes, industrial radiography, etc. Industrial hygiene engineers will find considerable opportunity for the exercise of their talents in the latter fields.

Radioisotopes are being supplied in increasing numbers, as indicated by data available from the Operations Division of the Oak Ridge National Laboratory (*3*). In Georgia, six establishments have been or are receiving radioisotopes: Camp Steel Works, Emory University, Georgia Experiment Station, Public Health Service in Savannah, Medical College of Georgia, and the University of Georgia School of Medicine (*4*). The isotopes shipped to date have included 6 curies of Co^{60} (metal), 23 units of Na^{24} of approximately 15 millicuries (mc.) per unit, 2 curies of I^{131}, 100 mc. of P^{32}, and 5 microcuries (μc.) of Cl^{36} (*4*). Of a total of 1,299.5 curies shipped from the Oak Ridge National Laboratory to non-AEC users from August 1946 through December 1950, a little over 8 curies have been shipped into Georgia.

Hazards

The potential hazards resulting from the use and discharge of these radioisotopes under conditions which exist in Georgia are considered here.

However, the principles and techniques described may be used for evaluating the hazards in any given geographic area, and are not restricted to conditions in Georgia.

External

Cobalt-60 (metal) will not be discharged as a waste. However, unless suitable precautions are taken to protect personnel from its ionizing radiations, it may be hazardous. The technique used in evaluating and reducing the external radiation hazard is illustrated by the following example.

One decay scheme that has been given for Co^{60} (*5*) shows that one beta particle and two gamma quanta are given off in cascade per disintegration. Neglecting the beta radiation, a curie of this isotope will emit quanta of each energy which are equivalent to 1 curie. Substituting in the approximate expression

$$R_f = 6\ C\ E$$

where

R_f = dosage rate in roentgens per hour (r./hr.) at 1 foot
C = number of curies of radioisotope emitting the gamma radiation (assuming 3.7×10^{10} disintegrations per second to be 1 curie)
E = gamma energy in million electron volts (Mev) per disintegration. Co^{60} has gamma energies for 1.1 and 1.3 Mev in cascade.

Then for a 6-curie source

$$R_f = 6\times6\times(1.1+1.3) = 86.4 \text{ roentgens/hour (r./hr.) at 1 foot.}$$

If we assume a dose rate of 0.04 r./week for a 40-hour week, then

$$\frac{0.04}{40} = 0.001 \text{ r./hr. or 1 milliroentgen per hour (mr./hr).}$$

The 6-curie source of Co^{60}, therefore, gives

$$\frac{86.4 \text{ r./hr.}}{0.001 \text{ r./hr.}} = 86{,}400$$

times the permissible dose rate at the 1-foot distance. The thickness of lead shield required to reduce the dose rate to 0.001 r./hr. may be found by means of the expression

$$I = I_o\, e^{-\mu t} \text{ or } \log \frac{I_o}{I} = 0.434\ \mu t$$

where

I_o = initial intensity
I = final intensity
μ = linear absorption coefficient taken as 0.65 $cm.^{-1}$ for lead and for 1.3 Mev gamma energy
t = thickness of absorber in cm.

The thickness of lead required for shielding will be 17.5 cm. or 6.9 inches.

To determine the dose rate at any distance other than 1 foot the inverse square law is applied. For example, if the external radiation at 1 foot is 86.4 r./hr., at 2 feet it will be $\frac{86.4}{(2)^2}$

Table 2. Characteristics of radioisotopes shipped into Georgia

Radioisotope	Suggested MPC value μc/cc.[1]		Radioactive half-life[2]	λ Decay constant[3] sec.$^{-1}$	Mg./curie[4]	MPC Mg./liter[5]
	In air	In water				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I^{131}	3×10^{-9}	3×10^{-5}	8.0 d	1×10^{-6}	0.81×10^{-2}	2.43×10^{-10}
P^{32}	1×10^{-7}	2×10^{-4}	14.3 d	5.59×10^{-7}	3.52×10^{-3}	7.04×10^{-10}
Na^{24}	2×10^{-6}	8×10^{-3}	14.9 h	1.29×10^{-5}	1.14×10^{-4}	9.1×10^{-10}
Cl^{36}	4×10^{-7}	2×10^{-3}	4.4×10^{5} y	4.99×10^{-14}	4.42×10^{-4}	8.84×10^{-2}
Co^{60}	1×10^{-6}	2×10^{-2}	5.2 y	4.23×10^{-9}	0.87	1.74×10^{-5}

[1] Morgan data.

[2] From National Bureau of Standards Circular NBS–499.

[3] $\lambda \text{ seconds}^{-1}=\frac{0.693}{\text{half-life in seconds}}$

[4] 3.7×10^{10} disintegrations per second $=\frac{0.693}{\text{T (half-life in days)}}\times\frac{\text{W (gm./curie)}}{\text{A (atomic weight)}}\times6.02\times10^{23}$ (Avagadro's number).

Therefore, W (gm./curie) $=7.67\times10^{-9}\ AT_D$ or W (mg./curie) $=7.67\times10^{-6}\ AT_D$.

[5] $\frac{\mu c}{cc.}\times10^{-6}\times10^{3}\frac{cc.}{liter}\times\frac{mg.}{curie}$; MPC value for water $\times\frac{mg.}{curie}$ value $=10^{-3}\times3\times10^{-5}\times0.81\times10^{-2}=2.43\times10^{-10}$.

or 21.6 r./hr., at 3 feet it will be $\frac{86.4}{(3)^2}$ or 9.6 r./hr., etc.

These calculations may be applied only when a point source of gamma activity is under consideration.

Internal

The remaining substances, I^{131}, P^{32}, Na^{24}, and Cl^{36}, could conceivably be discharged into the sewerage system after use as therapeutic agents or in research. These substances have MPC values in water or air as indicated in table 2. These values indicate that with the exception of Cl^{36} and Co^{60} the amounts dealt with are exceedingly small—quantities of the order of 10^{-10} parts per million (ppm). Concentrations in terms of ppm and ppb (parts per billion) are well known to public health personnel, but these for radioactive substances may be 10 million times lower. The amount of radioactive material which represents 1 curie of each of these substances is also indicated in table 2.

Some sample calculations follow which indicate the methods that may be used for estimating the degree of hazard resulting from the use and disposal of radioisotopes. The examples will be confined to radioisotopes that have been shipped into Georgia. In the initial calculation the following assumptions were made:

1. The activity is assumed constant—no decay. Actually, the radioactive decay of the isotope is not negligible, as will be shown later for I^{131}.

2. The radioisotope is discharged completely—no loss through usage. Again this effect may not be negligible and will be illustrated in the case of I^{131}.

3. Each radioisotope acts independently.

4. All radioisotopes, with the exception of the Co^{60} (metal), are received and discharged in 1 week.

If the number of millicuries of each radioisotope is divided by the tentative MPC value for that radioisotope in water or air, a value in terms of volume is obtained:

$$\text{Millicuries}\times\frac{\text{cubic centimeters}}{\text{millicuries}}=\text{cubic centimeters.}$$

This volume is equivalent to the dilution required to make the given amount of radioisotope innocuous (innocuous in the sense that no detectable injury, based on our present knowledge, will result from continuous exposure to the radioisotope).

Table 3. Dilution required to reduce amount of radioisotope shipped to tolerance

Radioisotope	Amount shipped	Dilution required		
		Cubic centimeters	Metric tons	Million gallons
I^{131}	2 curies	$\frac{2\times10^{6}\ \mu c}{3\times10^{-5}\ \mu c/cc}=0.67\times10^{11}$	0.67×10^{5}	17. 7
P^{32}	100 mc	$\frac{100\times10^{3}}{8\times10^{-4}}=0.50\times10^{9}$	0.50×10^{9}	0. 13
Na^{24}	23 units at 15 mc./unit	$\frac{23\ (15)\times10^{3}}{2\times10^{-3}}=0.44\times10^{8}$	0.44×10^{3}	0. 01
Cl^{36}	5 μc	$\frac{5}{2\times10^{-3}}=0.25\times10^{4}$	0.25×10^{-2}	
Total				17. 84

The volumes of water required to dilute the wastes to the MPC values given in table 2 are determined as indicated in table 3. These calculations show that approximately 17.84 million gallons of water would be required to dilute to the MPC value all of the radioisotopes except Co^{60} (metal) shipped into Georgia. This volume of water is slightly greater than the volume of water—about 14 million gallons per day (mgd)—supplied daily to the inhabitants of Savannah (*6*). With uniform discharge throughout the week, approximately 2.55 mgd would be required for dilution, or a stream having a discharge of approximately 4 cubic feet per second would suffice when radioactive decay is not considered.

The example cited above shows that it is possible to reduce the activity to the MPC value by diluting with water. Another method of dilution proposed is that of isotopic dilution. In isotopic dilution a carrier having chemical characteristics identical to those of the radioactive substance itself is added. The method is based upon the principle that the body (or any living form) does not distinguish between isotopes of the same element. Hence, since it can accept only certain concentrations of a specific nontoxic substance, excesses will be excreted or discharged, and the radioactive form of an element may be diluted with its stable isotope to such a concentration that when taken into the body the amount of the radioactive form retained will be below the maximum permissible concentration. This is one possible means of reducing concentration by lower forms of plant or animal life. Isotopic dilution generally is not required and in most instances is not practical.

Discharge of I^{131} From Hospitals

The effect of decay will now be taken into account. For purposes of illustration, assume that a hospital in Savannah receives 100 mc. of I^{131} for hyperthyroid and cancer therapy, and that a portion of this material will be discharged along with the wastes from the hospital. According to Butrico (*7*) large quantities of iodine are excreted from the kidneys after administration, and close to 100 percent of a large dose may be found in the urine over a period of several days. He reports that other investigators found that over a 5-day period normal individuals had urinary excretions of 80 percent of the administered dose. It may be stated that with most patients approximately 50 or 60 percent of the administered dose is excreted in the first 24 to 48 hours. These urine wastes constitute the bulk of the radioactive wastes resulting from the use of I^{131}.

If we assume that 100 mc. of I^{131} are given to a patient at time zero and that 55 mc. of I^{131} are discharged in the urine during the first day, a curve indicated by the heavy solid line in figure 1 is obtained. This shows that during the first day 8.5 percent of the I^{131} was lost through decay, and that with a discharge of 55 mc. in the urine the patient retained 36.5

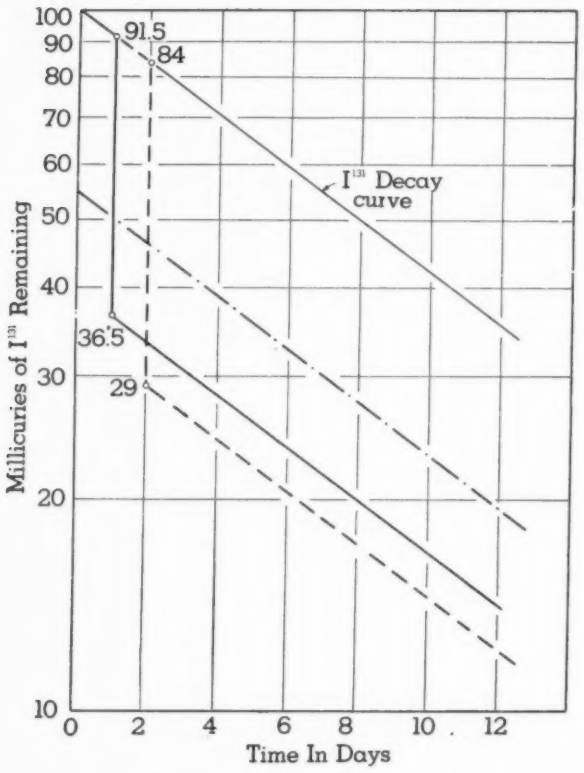


Figure 1. Disposal of I^{131} from a hospital.

mc. of I^{131}. If we assume that 55 mc. of activity are discharged in 48 hours (simplified here to show all discharge—heavy dash line—on the second day) the patient retained 29 mc. of the I^{131}, since 16 percent of the activity is lost through decay. The amount of activity retained by the patient will decrease by decay as shown by the curves. Decay will reduce the 55 mc. of iodine discharged as shown by the dot-and-dash line, so that after 1 day about 50 mc. will remain, after 2 days about 46 mc., and after 8 days, 27.5 mc. The amount of water required to reduce the 55 mc. of I^{131} to the tolerance concentration of 3×10^{-5} μc/cc. will be approximately 0.5 million gallons (mg.). If the 55 mc. of I^{131} are discharged from a 1,000-bed hospital there would be available for dilution only about 200,000 to 400,000 gallons per day of sewage. Therefore, the sewage would contain 1.25 to 2.5 times the maximum permissible concentration of I^{131}, if discharged uniformly throughout the day. This activity would be diluted further by the flow in the sewer. With I^{131}, because of its short half-life, 8 days, there is little likelihood of any radiation hazard.

Disposal of I^{131} by Sewage Treatment

Let us trace the sewage containing I^{131} through the sewer to its ultimate point of discharge—directly to a receiving stream or after passage through a sewage treatment plant. The raw sewage solids will take up some of the radioactive iodine, perhaps up to 20 percent (*8*). Bacterial slime on the sewer wall may also account for the removal of additional amounts of radioiodine. If no sewage treatment plant is available, the wastes containing the 55 mc. of activity noted above (reduced by an amount for decay) will be discharged into the stream as shown by line *A–F–G* in figure 2. The effect of various sewage treatment processes is illustrated in somewhat simplified form. Note the change in horizontal scale after 0 to 1 days.

If primary treatment alone is provided, the activity will be reduced by decay and sedimentation only, as shown by *O–A–B*.

O–A. Travel time in the sewerage system before entering the sewage treatment plant. The loss here is due to decay only.

A–B. Removal of radioactive material taken up by suspended solids removed by the primary settling basin. The position of point *B* is found as follows: 20 percent of the I^{131} is taken up by the suspended solids and 60-percent removal of suspended solids is attributed to sedimentation.

B–On The effect of decay beyond *B* is shown by *B–C* and the dotted line.

If the plant includes primary sedimentation and trickling filters, the activity will be reduced as follows:

O–A. Travel time in the sewerage system before entering the sewage treatment plant. The loss is due to decay only.

A–B. Removal of radioactive material by the primary settling basin. See *A–B* above.

B–D. Removal by trickling filter operating at rate of 2 million gallons per acre per day. Studies by Carter (*9*) indicated 85-percent removal by filter and secondary sedimentation.

D–On. Loss in effluent due to natural decay. In 20 days' time the activity will have been reduced to about 2.4 percent.

If the plant is of the activated sludge type with primary sedimentation, aeration, and secondary sedimentation, removals as indicated by the dash line in figure 2 may be obtained.

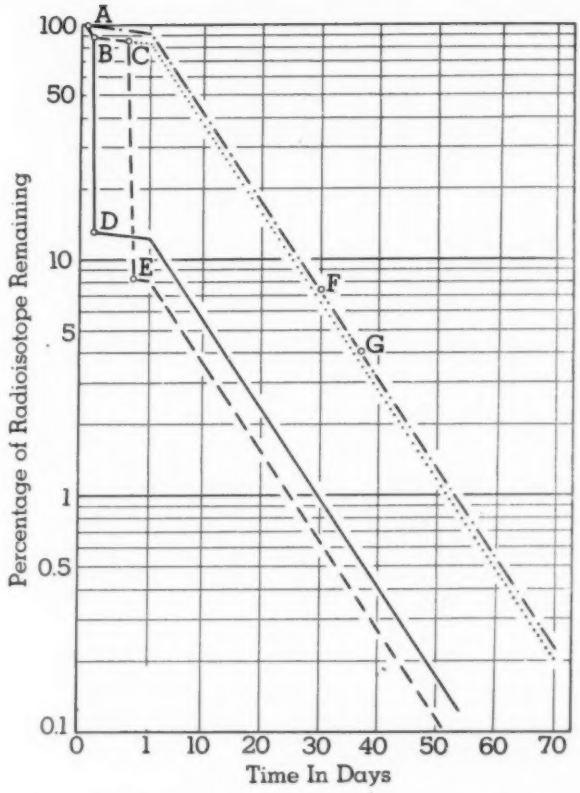


Figure 2. Removal of I^{131} by sewage treatment processes.

O–A. Loss due to decay.
A–B. Removal by primary sedimentation.
B–C. Loss due to decay during 12-hour aeration period.
C–E. Loss due to removal of suspended solids in secondary clarifier, assuming 95-percent removal of initial activity (*8*).
E–On. Loss by decay.
Note change of horizontal scale after 0 to 1 day.

The sludge which accumulates from primary and secondary sedimentation may be digested and the activity contained therein will reduce according to the dot-and-dash line. Point *F* indicates the percent reduction in activity following 30 days' digestion and point *G* represents additional decay due to 7 days' drying on sand beds. If the sludge is stored, activity will decrease as indicated beyond point *G*.

Other treatment processes have been suggested for different radioisotopes. The methods that have been investigated include evaporation, co-precipitation, ion exchange, biological processes, metallic displacement, sand filtration, and crystallization. Until the use of radioisotopes becomes much more widespread, or reactors are built for power or other purposes, the radioactive waste disposal problem probably will be a minor one in most States.

Removal of I^{131} and P^{32} by Water Treatment Processes

Let us now consider what takes place when a stream which contains I^{131} or P^{32} is used as a source of water supply (fig. 3). In this case assume that 2 weeks' storage is provided in a reservoir before treatment and the plant includes orthodox coagulation, settling, and filtration. Consider first a source containing I^{131}.

Two weeks' storage will reduce the activity to that represented by point *B*. If alum coagulation is used along with sedimentation and filtration no appreciable removal of I^{131} (less than 0.4 percent) will be obtained (*10*). However, the addition of small amounts of carbon, copper, or silver may increase removals to 75 percent. This removal is indicated by point *C*. Chlorination and storage have no effect on removal, although there will be some reduction due to decay as shown by the heavy solid line beyond *C*.

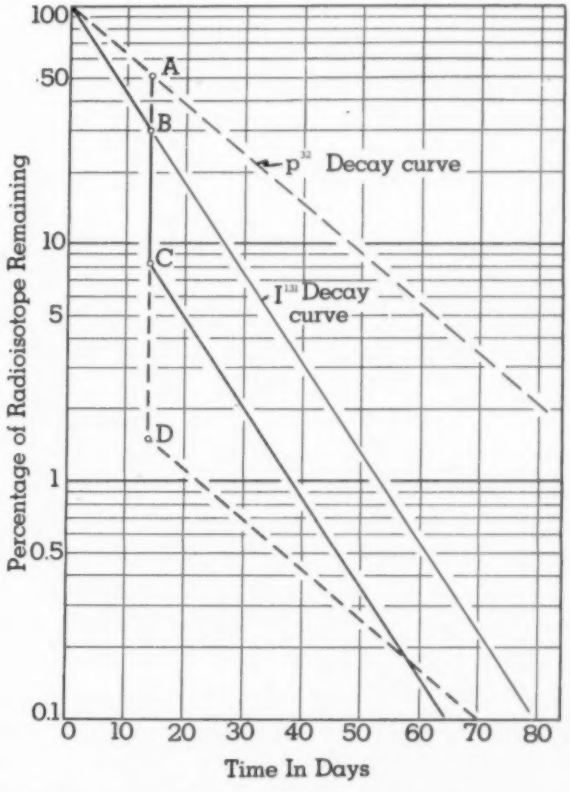


Figure 3. Removal of I^{131} and P^{32} by water treatment processes.

If the surface source of supply contains P^{32}, which has a half-life of 14.3 days, 2 weeks' storage will reduce the activity to the value indicated for point *A*. Alum coagulation, settling, and filtration will account for a removal of 96 to 98 percent (*10*), which reduces the activity to the value shown at *D*. Beyond this point decay will account for additional reductions as indicated by the dash line.

Mixtures of radioisotopes may or may not be removed, depending upon the radioisotopes comprising the mixture. Mixed fission products activity, for example, may be reduced by approximately 50 percent by coagulation and settling, and filtration may increase removals to 70 percent (*8*).

At this time a point should be discussed which is obvious to many but may be somewhat confusing to some and that has to do with percent removal. The percent removal has little significance unless one knows the original concentration of radioactive material. If, for example, a waste contained an I^{131} concentration of 1 mc./cc., it would be necessary to obtain a removal of 99.999997 percent to reduce the original I^{131} present to the MPC. If our processes will effect a 95-percent reduction, the highest initial concentration of I^{131} that would be permissible in order to meet these requirements after treatment would be 6×10^{-4} μc/cc. Any concentration greater than this would result in an effluent containing concentrations in excess of the MPC values.

Explosion of a nuclear bomb will result in the release of considerable amounts of radioactivity. The effect of this on the water supply will depend upon the nature of the blast and atmospheric conditions at the time of the blast. Georgia is perhaps a little more fortunate than many States with respect to contamination of surface water supplies following a nuclear explosion, since about 30 percent of the population served by public water supplies use ground water sources of supply. Approximately 66 percent of the public water supplies are from deep wells (*6*). There is little likelihood that these would become contaminated during an emergency, and they should serve as a source of supply if the distribution systems are not destroyed or damaged.

Concluding Statement

With the emphasis that is being placed on civil defense activities at present, much has been said about the need for providing facilities for measuring radioactivity. This equipment is rather expensive and may even be in relatively short supply. It is my personal belief that much can be accomplished now through the cooperative use of existing facilities in hospitals and research centers to familiarize public health personnel with the techniques of counting, sample preparation, and measurement of radioactive materials. Such cooperative effort will permit water and sewage treatment plant operators to determine for themselves the amounts of radioactive materials that are being discharged into sewerage systems and water courses and to evaluate the possible potential hazard from this discharge.

ACKNOWLEDGMENT

The author acknowledges the assistance of Dr. K. Z. Morgan, for granting permission to use the data in table 1; of the Operations Division of the Oak Ridge National Laboratory, for data on radioisotope shipments; and of Dr. Elda E. Anderson and Dr. Forrest Western, for review of the material and for their suggestions. The work described in this report was performed at the Oak Ridge National Laboratory for the Atomic Energy Commission under contract No. W-7405-Eng-26.

REFERENCES

(*1*) Hollis, Mark D.: Environmental health. A critique. Pub. Health Rep. 66: 13, 400–409 (1951).

(*2*) Morgan, K. Z., chairman, Subcommittee on Internal Dose of the National Committee on Radiation Protection: Maximum permissible amounts of radioisotopes in the human body and maximum permissible concentrations in air and water, September 21, 1951.

(*3*) Straub, Conrad P.: Disposal of radioisotopes—A method of evaluating potential hazard. Unpublished information. Oak Ridge National Laboratory, Oak Ridge, Tenn., 1951.

(*4*) Oak Ridge National Laboratory, Oak Ridge, Tenn., Operations Division: Unpublished communication.

(*5*) Morgan, G. S.: Some practical considerations in radiation shielding. Circular B–4 Oak Ridge, Tenn., U. S. Atomic Energy Commission, Isotopes Division, 1948.

(*6*) U. S. Public Health Service: Inventory of water and sewage facilities in the United States. 1945. Cincinnati, Ohio, 1948.

(7) Butrico, Frank A.: Disposal of radioactive wastes from Massachusetts General Hospital. (NP-1623. Massachusetts Institute of Technology). Oak Ridge, Tenn., U. S. Atomic Energy Commission, Technical Information Division, ORE.

(8) Straub, Conrad P.: Treatment and disposal of liquid radioactive wastes. *In* Industrial wastes treatment. Reinhold Corp., N. Y., 1952.

(9) Carter, Melvin W.: Study on the removal of radioactive iodine (I^{131}) by laboratory sewage trickling filters. Master's thesis. Atlanta, Ga., Georgia Institute of Technology, 1951.

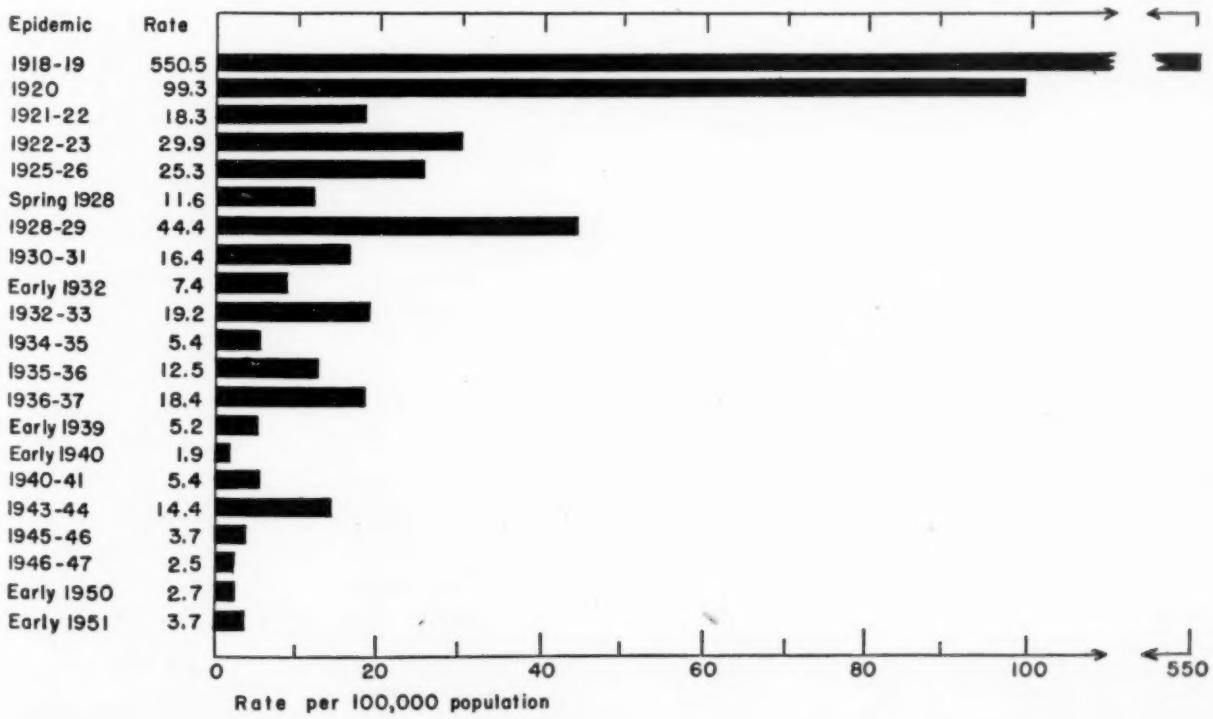
(10) Straub, Conrad P.: Observations on the removal of radioactive materials from waste solutions. Sewage & Indust. Wastes 23: 188–193 (1951).

Excess Mortality From Influenza and Pneumonia

Excess mortality from influenza and pneumonia is used as the best available measure of epidemic periods and of the size and importance of an epidemic. The chart shows the excess mortality per 100,000 population during the whole of each epidemic in groups of cities in the United States, 1918 to 1951.

The decrease in excess mortality may be related to one or more of several things: (1) The mortality of diseases designated as influenza may be decreasing by reason of change in what is now diagnosed as influenza, because of recently acquired knowledge of the etiology and the early clinical manifestations of the disease; (2) influenza fatality may be decreasing by reason of (*a*) greater natural immunity acquired by more individual contact with the disease because of greater movement of the population; (*b*) milder strains of the virus becoming widespread; or (*c*) more successful treatment of influenza and its most frequent complication, pneumonia, by the use of the newer chemotherapies.

Aside from epidemic peaks, the death rate from influenza and pneumonia in the United States decreased from roughly 200 per 100,000 in 1900 to 100 in 1937, when the trend turned sharply down, to about 35 in 1950. (See "Trends and Epidemics of Influenza and Pneumonia, 1918–51," by Selwyn D. Collins and Josephine Lehmann, *Public Health Reports*, Vol. 66, No. 46, November 16, 1951.)



Bait Shyness to ANTU In Wild Norway Rats

By T. B. GAINES and W. J. HAYES, Jr., M.D.

In spite of the fact that certain deficiencies limit the usefulness of alpha-naphthyl thiourea (ANTU) as a rodenticide under operational conditions, it is safe and, when used infrequently, effective in controlling populations of Norway rats.

No controlled study appears to have been made on the persistence of tolerance and/or bait shyness to ANTU under field conditions. Therefore, the present study was conducted to determine what effect ingestion of a sublethal dose of ANTU would have on the subsequent acceptance of the poison by Norway rats and their intoxication by it. Laboratory and simulated field studies were made. In each instance, the rats had available a supply of wholesome food, so that they were not limited to the dilemma of poison or starvation.

The use of ANTU as a rodenticide was developed by Richter (*1*) during World War II. The compound differs from other common rodenticides in its relative specificity for Norway rats; it is essentially ineffective against roof rats, and impractical for their control. However, its use has been advocated on the basis of effectiveness and safety (*2*). Although the compound is highly toxic to pigs, to cats, and especially to dogs, it is significantly less toxic to many other species of domestic animals, and it is estimated that man also is highly resistant to the poison (*1*, *3*, *4*). Before the introduction of warfarin, ANTU was considered the safest rodenticide, with the exception of red squill (*5*).

Richter (*6*) demonstrated in the laboratory that Norway rats with no choice of wholesome food developed a tolerance and refusal response for ANTU-poisoned bait which persisted, in general, less than a month. The persistence of tolerance and/or bait shyness for a month under field conditions would present a distinct but minimal disadvantage. Actual field experience (*2*) has shown that this disadvantage of ANTU may be important if the compound is used more often than once a year on the same premises.

Materials and Methods

The technique used for collecting and maintaining wild Norway rats was the same as that described in an earlier article (*7*). The procedure for the laboratory, as well as for simulated field studies, was to give the rats a sublethal dose of ANTU in bait and, after an interval, to test the reaction of the rats to the same poison in the same bait (group I). Two kinds of control groups were used: group II, those which were sublethally poisoned and later were offered ANTU in a different bait from that used for the sublethal dose; and group III, those which had had no previous experience with the poison whatever.

In giving the sublethal dose, it was considered highly important to have the rats take it voluntarily so that the conditions of the experiment would resemble those of the field

Mr. Gaines is a biologist and Dr. Hayes is a senior surgeon assigned to the technical development branch of the Communicable Disease Center, Public Health Service, Savannah, Ga.

as closely as possible. To accomplish this, ANTU was mixed in yellow corn meal (maize) at the rate of 0.1 percent by weight (1 mg./gm.). This bait was then weighed out individually for each rat used in laboratory experiments, in such a way that if the rat ate its entire portion it would consume 6 mg. of ANTU per kilogram of body weight (rats tested after 1 or 2 weeks) or 5 mg./kg. (rats tested after 1, 2, and 3 months). Rats which failed to take the entire portion within a 2-day period, as well as those which died as a result of the dose, were discarded. Rats which ate the poisoned corn meal properly were placed in stock cages and held on a diet of Purina Laboratory Chow for the appropriate number of weeks or months before testing.

All poison bait used either for the "sensitizing" dose or for the final tests in the laboratory or in the field was thoroughly mixed for 15 minutes with an electric food mixer. In the laboratory, all bait was fed in nonspillable food cups to rats individually caged in Army Medical School-type cages. During the actual tests, each rat was offered a choice of a weighed ANTU-poisoned bait and another bait which was identical except for the omission of ANTU. The baits were exposed for 2 days, after which they were reweighed and the consumption was computed. Surviving rats remained under observation for a week after the poison was removed; they were not reused for a second test.

The simulated field tests were conducted in a manner basically similar to that used in the laboratory. Rats were housed in wooden, barracks-type buildings, measuring about 20 by 100 feet. These buildings were ratproofed and supplied with ample harborage, consisting of boxes, paper, and other rubbish. Each building was artificially infested with rats at least 6 weeks before the tests were started. Before and during the test periods the rats were maintained with liberal supplies of corn meal and wheat shorts as well as water.

The ANTU-poisoned bait was distributed in the buildings in patches of approximately a heaping teaspoonful each near the harborage and along the runways. It was left exposed to the rats for 2 days and then was removed by sweeping. No attempt was made to determine the amount of bait consumed in the buildings. Two to three days later, the harborage was removed piece by piece; the dead rats were picked up and all the survivors were caught by hand in the empty room. Rats which survived the poisoning were then returned to the building, and the harborage was returned each time until the study was completed. The original sensitizing dose was given by offering ANTU in ground laboratory chow at a concentration of 0.1 percent by weight.

The simulated field tests differed from those in the laboratory in the following ways:

1. There was no assurance that every rat which survived the sensitizing dose of ANTU actually took any of the compound.
2. The sensitizing dosage of ANTU consumed by rats in the barracks-type buildings undoubtedly varied considerably on a milligram-per-kilogram basis. It was considered more valuable to simulate field conditions closely than to use an exact dosage.
3. In the 2-, 3-, and 4-month tests, some immature rats never had an opportunity to encounter a sensitizing dose of ANTU before they received the final dose.
4. Certain adult rats in the later simulated tests had more than one opportunity to take a small sensitizing dose. (The duration of bait shyness was measured from the last sensitizing exposure.)

After the sensitizing dose had been given, all rats in laboratory or simulated field experiments, except those tested in the laboratory after only 1 week, were offered ANTU at a concentration of 2.0 percent by weight. The latter animals received 1.0 percent ANTU, but the mortality of the controls was considered too low. Consequently, the higher concentration of poison was adopted for the remainder of the experiment. Concentrations of 1.0 to 5.0 percent are commonly recommended for field use.

Results

Laboratory Tests

The results of the laboratory studies are presented in table 1. Test animals had previously ingested ANTU in corn meal at a dosage of 5 mg./kg., except those held 1 and 2 weeks, which ingested ANTU at a dosage of 6 mg./kg. Group III rats were previously untreated. The

Table 1. Effect of the voluntary ingestion of a sublethal dose of ANTU in bait by wild Norway rats upon their subsequent acceptance of and intoxication by ANTU in bait

Concentration of ANTU (percent)	Time since ANTU last ingested	Group No.	Bait	Number rats	Body weight (gm.)		Percent mortality	Bait consumed per rat (gm.)				Ratio mean p/p-f [1]	Rats refusing bait (percent)	
								Poisoned		Poison-free				
					Range	Mean		Range	Mean	Range	Mean		Poisoned	Poison-free
1.0	1 wk	I	C. M.[2]	12			33	0.2–1.1	0.5	0.5–5.7	2.5	0.20	42	33
	1 wk	II	L. C.[3]	12			33	.2–1.5	.6	.3–5.0	2.6	.23	8	58
		III	C. M.	13			62	.3–0.8	.5	1.0–2.7	1.6	.31	15	38
		III	L. C.	16			69	.2–0.5	.4	.4–2.6	1.1	.37	19	44
2.0	2 wks	I	C. M.	14	170–394	246	14	.2–0.5	.3	.5–5.4	1.4	.21	36	50
	2 wks	II	L. C.	15	166–440	264	67	.2–0.8	.4	.5–5.5	2.9	.14	13	27
		III	L. C.	20	170–388	254	85	.2–1.1	.6	.6–6.0	4.1	.15	5	45
	1 mo	I	C. M.	17	166–332	251	6	.4–0.8	.7	.9–8.0	3.6	.20	76	71
	1 mo	II	B. C.[4]	17	163–362	236	71	.3–1.5	.8	.8–9.1	2.4	.33	12	29
		III	L. C.	16	156–440	277	94	.5–2.8	1.2	.5–7.1	1.5	.80	6	25
	2 mos	I	C. M.	12	221–351	274	25	.2–0.8	.5	.9–4.3	2.0	.25	50	25
	2 mos	II	L. C.	15	190–375	282	33	.2–1.3	.6	1.0–10.0	4.5	.13	33	40
		III	L. C.	15	152–297	207	73	.3–1.1	.6	1.0–2.0	1.4	.43	7	40
	3 mos	I	C. M.	13	197–377	306	23	.2–1.5	.6	1.0–10.0	3.0	.20	38	38
	3 mos	II	L. C.	12	213–495	333	67	.3–1.1	.9	.5–8.5	3.5	.26	17	25
		III	C. M.	13	187–515	330	54	.2–1.4	.7	.5–2.3	1.7	.42	23	50

[1] Poisoned/poison-free. [2] Corn meal. [3] Laboratory chow. [4] Bread crumbs.

mortality (6 to 33 percent) among group I rats previously poisoned by ANTU in the same bait is significantly different from the mortality (54 to 94 percent) among group III rats used as untreated controls. The fact that the previously treated rats which were offered ANTU in corn meal in these tests generally took a larger proportion of their total food from the poison-free bait than did rats in group III indicates that the specific ANTU-bait combination was detected by the group I rats. Furthermore, among the same previously poisoned rats there was not much difference in the percentage of those which refused poisoned bait and those which refused poison-free bait, suggesting that the refusal response was partially directed at the corn meal as such, although the possibility that the refusal of unpoisoned bait may have been caused by illness induced by eating the poison must be considered, as shown by Richter (*6*).

There was some advantage in using an alternate bait against previously poisoned rats, although the mortality (group II, 33 to 71 percent) was generally less than among rats used as untreated controls (group III, 54 to 94 percent). These results suggest that Norway rats detect ANTU as such and are not entirely dependent for their protection on an association between previous illness and a particular kind of food (in this instance, corn meal).

In the laboratory tests, bait shyness did not appear to increase or decrease when tested at intervals of 1 and 2 weeks and 1, 2, and 3 months. Under the conditions of the experiment, bait shyness lasted for an undetermined period greater than 3 months.

The actual consumption of ANTU was computed individually for each rat on a milligram-per-kilogram basis. A review of these figures showed that, on the average, rats previously exposed to ANTU were killed by the same small dosage which killed the previously unexposed controls. There was, then, no evidence for the presence of tolerance. It should be recalled, however, that the experiment was not designed for the study of tolerance, and its presence, as a minor factor, is not excluded.

Simulated Field Tests

The experimental design and summary of tests conducted with ANTU-poisoned bait against wild Norway rats living under simulated field conditions from March 31, 1949, to February 6, 1950, are presented in table 2. All rats had been in their respective buildings at least 6 weeks before they were exposed to ANTU. A breakdown of the same data for adult and immature rats is given in table 3. The mortality among all rats previously offered ANTU in the same bait was very low (group I: 0.0 to 47.7; average 15.3 percent) as compared with the mortality among rats used as untreated controls (group III: 50.7 to 80.0; average 68.1 percent). The use of different bait against rats of group II previously exposed to ANTU gave a mortality of 2.9 to 23.4 percent (average, 16.2 percent). This result confirms the presence of bait shyness to ANTU, but it fails to support the idea that this bait shyness is augmented when the poison is presented a second time in the same bait. Although the figures differ, the result is the same whether one considers the entire populations or only the adult rats which were tested.

Bait refusal among rats previously exposed to ANTU persisted unchanged for at least 4 months from the time they were last exposed.

As expected, the percentage mortality was much greater among adult rats than among immature rats (table 3). Richter (*6*) has estimated that young rats are six to seven times more resistant than adults.

It may also be noted that, although the present experiments were not designed to test the importance, which has been noted by others, of

Table 2. Experimental design and summary of results of simulated field tests with ANTU

Date	Item	Building No.				
		5021	5022	5023	5024	5026
Mar. 31, 1949	Group No	S [1]	S [1]			
	Bait	L. C.[2]	L. C.[2]			
	ANTU (percent)	0.1	0.1			
	Total population	33	71			
	Number surviving	26	66			
	Mortality (percent)	21.2	7.0			
May 2, 1949	Group No	II	I	III		
	Bait	B. C.[3]	L. C.[2]	L. C.[2]		
	ANTU (percent)	2.0	2.0	2.0		
	Total population	25	52	69		
	Number surviving	20 [4]	48	34		
	Mortality (percent)	20.0	7.7	50.7		
July 5, 1949	Group No		II	I		III
	Bait		B. C.[3 5]	L. C.[2]		L. C.
	ANTU (percent)		2.0	2.0		2.0
	Total population		47	51 [4]		30
	Number surviving		36	48		6
	Mortality (percent)		23.4	5.9		80.0
Oct. 5, 1949	Group No		II	I	III	
	Bait		C. M.[6]	L. C.[2]	L. C.[2]	
	ANTU (percent)		2.0	2.0	2.0	
	Total population		102	44	53	
	Number surviving		99	23	14	
	Mortality (percent)		2.9	47.7	73.6	
Feb. 6, 1950	Group No		II	I		
	Bait		L. C.	L. C.		
	ANTU (percent)		2.0	2.0		
	Total population		92	76		
	Number surviving		75	76		
	Mortality (percent)		18.5	0.0		

[1] Rats receiving sensitizing dose.
[2] Laboratory chow.
[3] Bread crumbs.
[4] Rats in building 5021 combined with those in 5023 on May 6, 1949.
[5] Containing 10 percent peanut butter.
[6] Corn meal containing 5 percent bacon grease.

Table 3. Mortality among adult and immature wild Norway rats poisoned with ANTU under simulated field conditions

Date of test	Months since last exposure	Group No.	Building No.	Adult rats			Immature rats		
				Number in building	Number dead	Percent mortality	Number in building	Number dead	Percent mortality
Mar. 31, 1949	----------	----------	5021	26	7	26. 2	7	0	0
	----------	----------	5022	28	5	17. 9	43	0	0
May 2, 1949	1	I	5022	22	4	18. 2	30	0	0
	1	II	5021	18	4	22. 1	7	1	14. 3
	----------	III	5023	32	28	87. 5	37	7	18. 5
July 5, 1949	2	I	5023	35	3	8. 6	16	0	0
	2	II	5022	47	11	23. 4	0	----------	----------
	----------	III	5026	30	24	80. 0	0	----------	----------
Oct. 5, 1949	3	I	5023	32	21	65. 6	12	0	0
	3	II	5022	46	3	6. 5	56	0	0
	----------	III	5024	38	37	97. 4	15	2	13. 3
Feb. 6, 1950	4	I	5023	43	0	0. 0	33	0	0
	4	II	5022	71	17	23. 9	21	0	0

season (*8*) or temperature (*9*) on the susceptibility of Norway rats, no effects correlated with season or temperature were noted.

Discussion

In the use of ANTU as a rodenticide one encounters the problem of bait shyness (secondary bait refusal). This study has shown that such shyness lasts at least 4 months under simulated field conditions. As already mentioned, Emlen reported that poor control may result if ANTU is used more than once a year on the same premises. Following control estimated at 85 to 90 percent, essentially isolated populations recover in 15 to 44 months, or at a rate of 2 to 6 percent per month (*2*, *10*). Under these circumstances, a large proportion of the rats present 1 year after the use of ANTU would be young adults which had never been exposed to the compound. Present field and laboratory experience cannot, therefore, rule out the possibility that bait shyness to ANTU in the Norway rat lasts more than a year, or even for the lifetime of the individual rat.

Regardless of the method by which ANTU is used, it must be recognized that there is a wide variation in its effectiveness against immature and against adult Norway rats (*1*, *4*). Its unsuitability for roof rats has already been mentioned.

What, then, is the status of ANTU in rat control? Its various deficiencies should not mask the facts that (*a*) when properly used for the first time against populations of Norway rats it gives rapid and acceptable control, and (*b*) among quick-acting rodenticides it has a good record of safety under conditions of actual use.

The use of ANTU or any other rodenticide should be accompanied by appropriate ratproofing and sanitation. Destruction of the remnant of population left after the use of any quick-acting rodenticide may best be accomplished by using a different poison. However, like ANTU, other quick-acting rodenticides induce bait shyness to some extent, and their value for repeated use is thus limited. Except for red squill, which is a relatively ineffective compound, none of the quick-acting materials offer the same degree of safety as does ANTU. The advantages of warfarin for eliminating the remnants of larger populations, or for maintaining what has been called chemical ratproofing, have recently been pointed out (*7*).

The failure of this study to demonstrate the presence of tolerance does not constitute any contradiction of earlier work on this phenome-

non. It does suggest that, under actual field conditions, bait shyness is a much more important factor than is tolerance in determining the outcome of control operations with ANTU. The study thus establishes a clear reason for the failure of ANTU to control Norway rats when used at too-frequent intervals.

Summary and Conclusions

1. Under laboratory conditions and with a free choice of food, Norway rats retained bait shyness to ANTU for 3 months following a single dose of it at the rate of 5 mg./kg.

2. Under simulated field conditions, bait shyness was demonstrated 4 months after the last exposure to ANTU. The time at which this reaction might eventually decrease was not determined.

3. Tolerance was not demonstrated, but, because of the nature of the tests, this result was not considered to rule out the presence of tolerance as a minor factor.

4. Bait shyness was considered a major factor limiting the usefulness of ANTU under operational conditions.

5. In spite of its deficiencies, ANTU presents the advantage of safety and, when used for the first time against populations of Norway rats, the advantage of effectiveness.

REFERENCES

(1) Richter, C. P.: The development and use of alpha-naphthyl thiourea (ANTU) as a rat poison. J. A. M. A. 129: 927–931 (1945).

(2) Emlen, J. T., Jr.: Baltimore's community rat control program. Am. J. Pub. Health 37: 721–727 (1947).

(3) Anderson, W. A., and Richter, C. P.: Toxicity of alpha-naphthylthiourea for chickens and pigs. Vet. Med. 41: 302–303 (1946).

(4) Dieke, S. H., and Richter, C. P.: Age and species variation in the acute toxicity of alpha-naphthylthiourea. Proc. Soc. Exper. Biol. & Med. 62: 22–25 (1946).

(5) Communicable Disease Center, Atlanta, Ga., Rat-borne disease: Prevention and control, Atlanta. 201–202 (1949).

(6) Richter, C. P.: Biological factors involved in poisoning rats with alpha-naphthylthiourea (ANTU). Proc. Soc. Exper. Biol. & Med. 63: 364–372 (1946).

(7) Hayes, W. J., Jr., and Gaines, T. B.: Control of Norway rats with residual rodenticide warfarin. Pub. Health Rep. 65: 1537–1555 (1950).

(8) Latven, A. R., Sloan, A. B., and Munch, J. C.: ANTU, the lethal dose. Soap and Sanit. Chemicals 24: 127–129, 131 (1948).

(9) Meyer, B. J., and Karel, L.: Effect of environmental temperature on alpha-naphthylthiourea (ANTU) toxicity to rats. J. Pharmacol. & Exper. Therap. 93: 420–422 (1948).

(10) Emlen, J. T., Jr., Stokes, A. W., and Winsor, C. P.: Rate of recovery of decimated populations of brown rats in nature. Ecology 29: 133–145 (1948).

Renewed Efforts To Uncover Scrap Metal Urged

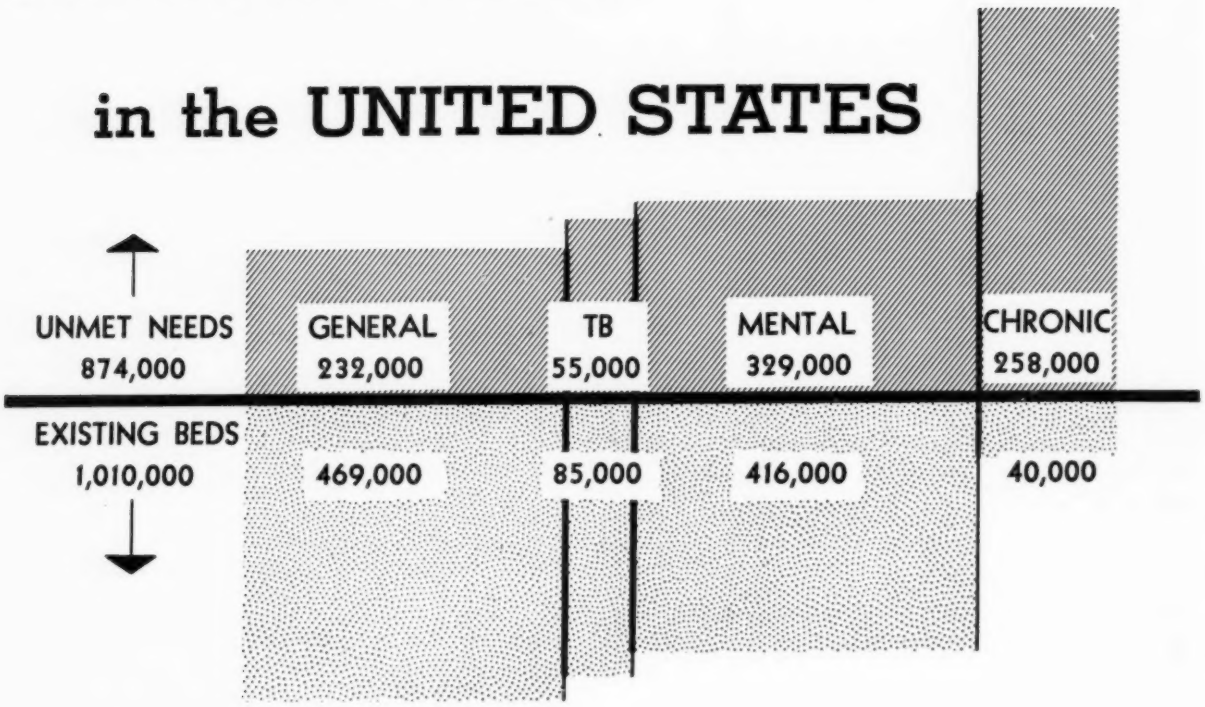
Defense Mobilization Director Charles E. Wilson has urged increased efforts to uncover supplies of metal scrap urgently needed by the Nation's mills and foundries so that maximum steel production might be maintained. Industry, business institutions, government agencies, and other organizations are requested to redouble their efforts to increase the flow of dormant scrap to the mills.

The Public Health Service, as that agency of the Federal Government most closely associated with health departments and hospitals of the country, has been asked to bring to the attention of these organizations the pressing need for scrap metal and to request an intensification of the effort to increase supplies.

Hospitals, health departments, and other agencies and institutions can aid materially in the drive by continually surveying their installations for obsolete and worn-out machinery and equipment and disposing of such items to local scrap dealers.

Public Health Service hospitals and installations have been directed to cooperate to the fullest extent possible in the drive.

HOSPITAL BEDS in the UNITED STATES



The Nation had over 1,000,000 acceptable hospital beds in 1951, in addition to about 190,000 beds in Federal Government hospitals, as shown by a summary of State hospital plans developed under the Hospital Survey and Construction (Hill-Burton) Act of 1946.

These plans define and identify acceptable beds and also provide an estimate of hospital bed needs. They show that adequate hospital care for the people of this Nation requires 874,000 more beds. Currently, 54 percent of the Nation's estimated hospital needs are being met by the present supply of acceptable hospital beds.

Assuming quality patient care, hospital beds may be regarded as symbols reflecting facilities for patient care. Present bed supply levels and needs for more facilities as of 1951 are summarized by major categories in the above chart.

Unmet Bed Needs

Most of the recent new construction has been general hospitals. This is reflected in the figures for the percent of total needs met by existing general hospital beds in 1948 compared with 1951. In 1948, 41 percent of general hospital bed needs were unmet. In 1951, 33 percent of the general hospital bed needs were unmet.

Construction of new chronic and mental beds just kept pace with needs due to population increase and the replacement of beds unsuitable for use. Two-thirds of the Nation's estimated 874,000-bed deficit is accounted for by the need for providing care for patients with chronic and mental illness. These two categories alone total 587,000 needed beds.

The number of beds suitable for providing tuberculosis hospital care, according to the Hill-Burton standard, has progressively increased. In 1951, 85,000 suitable tuberculosis beds were available, and about 55,000 more were needed. The criterion for determining tuberculosis bed needs differs from that used in determining general, chronic, and mental bed needs. Annual deaths from tuberculosis in a State are used rather than a population basis, as in the case of the other groups.

Early diagnosis and improved treatment methods for tuberculosis have increased the length of patients' lives. The need for beds for tuberculous patients is therefore increasing rather than decreasing. A better standard for determining tuberculosis bed needs, based on reliable morbidity data, is needed. Until such data are available, prevalence rates offer a means for estimating more adequately goals for the construction of hospital facilities for the treatment of the tuberculous.

Bed Needs of the States

These data are for the Nation as a whole. What about the States? Do hospital needs differ between States and within a State? Fortunately, State plans include a con-

---

This report was prepared by the Division of Hospital Facilities of the Bureau of Medical Services, Public Health Service.

tinuous inventory of existing hospital beds with an indication of their suitability for use as determined by each State.

The Hill-Burton standard, as set by Title VI of the Public Health Service Act, is: 4.5 to 5.5 beds per 1,000 population for general hospital construction, depending upon population density; 5 beds per 1,000 population for the mental diseases; 2 beds per 1,000 population for the chronic diseases; and 2.5 beds per average annual deaths from tuberculosis over a 5-year base period.

No State has yet met the Hill-Burton standard in all four bed categories. Only three States have met or exceeded the standard in the general bed category. These are, however, States where population densities are low. Despite the apparent meeting of general hospital bed needs on a state-wide basis, there are still large areas within these States where needs have not been met. Existing beds are either concentrated in a few areas or the population distribution is such that many people still do not have access to hospital facilities.

The state-by-state record of existing acceptable hospital beds at the end of 1951 is shown in the accompanying table, together with ratios for the continental United States.

The effect of the existing standard on meeting needs for beds for tuberculous patients is reflected in the fact that seven States are shown as either having met or exceeded the standard.

The need for hospital beds for patients having mental and chronic diseases is reflected in the low ratios reported by many of the States.

Hill-Burton Construction

In 1946, with the passage of the Hospital Survey and Construction Act, the country was provided with a systematic, nation-wide hospital construction program utilizing financial aid from the Federal Government.

The program first aims to assist States in determining their need for hospital and health center facilities and in planning for the provision of needed facilities. Second, it assists the States in carrying out these plans by financial aid for the construction

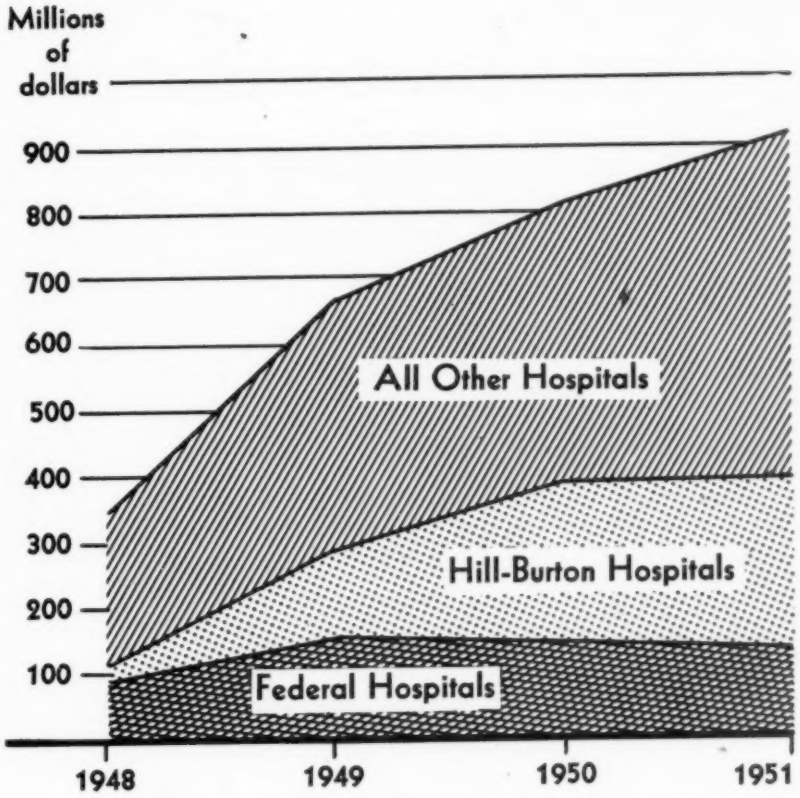


Figure 1. Value of construction put in place.

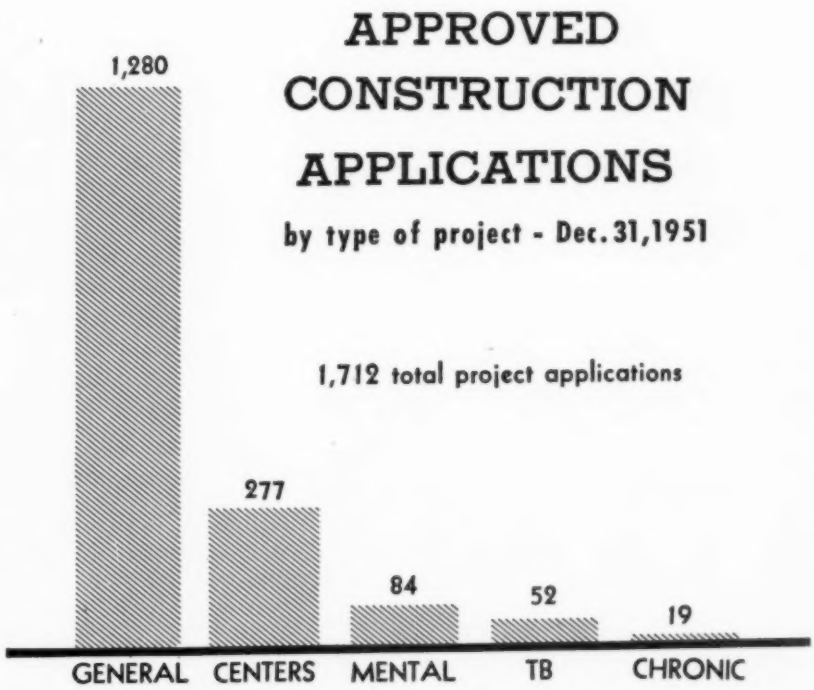


Figure 2. Distribution of approved project applications, December 31, 1951.

of needed hospitals and health facilities.

Since 1948, Hill-Burton-aided hospitals have constituted a significant and increasing proportion of the dollar value of hospital construction put in place. By the end of 1951, these hospital and health center facilities amounted to more than one-fourth of the dollar value of all hospital construction put in place, as shown by figure 1.

As of the end of the calendar year 1951, 1,712 project applications for hospitals and health centers have been approved by the States and the Public Health Service. These projects add 82,000 hospital beds and 277 public health centers to the hospital and health resources of the Nation.

These 277 health centers do not include 46 health centers combined with general hospitals. The total cost of constructing these facilities—$1,275,000,000—is being met by 830 million dollars in State and local funds and 445 million dollars in Federal aid. The distribution of the 1,712 projects is shown by type in figure 2. Of these projects, 75 percent are for general hospital construction, adding 65,000 beds; 16 percent, for public health centers; 5 percent, for mental hospitals, adding 10,000 beds; 3 percent, for tuberculosis hospitals, adding 5,000 beds; and 1 percent, for chronic disease hospitals, adding 2,000 beds.

Under the Hill-Burton program, new hospitals and health centers are being built, principally in rural areas, where none had previously existed. Of 700 completely new general hospitals approved for construction, more than 400 are located in communities which had no hospital facility prior to the beginning of the program. An additional 130 hospitals replaced unsuitable facilities. Nearly three-fifths of the new projects are located in communities of less than 5,000 people.

Public Health Centers

There is growing acceptance of the principle that hospitals and local health departments must operate as a community health team in the interests of economy, efficiency, and improved health service. As State plans evolve through constant revision there are developing patterns of integrated hospital and health center facilities. Already 46 combined hospital and health centers have been approved for construction.

Combining a general hospital with a health center is one means of

Existing acceptable hospital beds in the United States, per 1000 population, 1951

State	General	Mental	Tuberculosis	Chronic
Hill-Burton Standard [1]	4.5	5.0	[2] 2.5	2.0
Continental United States	3.2	2.8	1.6	0.3
Alabama	2.4	1.2	0.5	-------
Arizona	3.8	1.8	1.1	.1
Arkansas	1.9	1.6	2.1	-------
California	3.0	3.4	1.4	.2
Colorado	4.4	4.4	4.7	-------
Connecticut	3.3	4.3	2.9	.4
Delaware	4.0	2.4	1.7	.8
District of Columbia	3.0	3.4	1.7	.2
Florida	3.3	2.5	2.5	.4
Georgia	2.6	3.2	1.4	.5
Idaho	2.7	1.6	1.0	.3
Illinois	3.3	2.2	1.8	.4
Indiana	2.1	2.5	1.1	.1
Iowa	3.4	1.2	1.6	.2
Kansas	3.5	3.2	1.4	.1
Kentucky	2.7	2.7	1.0	.1
Louisiana	3.7	2.3	1.5	.1
Maine	2.1	3.3	1.4	.2
Maryland	3.3	2.8	1.5	.8
Massachusetts	2.8	4.6	2.3	.4
Michigan	2.4	1.9	2.1	.2
Minnesota	3.8	3.0	3.1	.2
Mississippi	2.6	1.8	.9	-------
Missouri	3.7	3.2	1.4	.3
Montana	6.4	3.9	1.5	-------
Nebraska	3.7	3.4	1.4	0.4
Nevada	4.7	1.8	.4	-------
New Hampshire	3.4	4.4	1.7	.1
New Jersey	3.4	3.1	1.9	.6
New Mexico	3.9	1.8	.8	.1
New York	3.4	4.2	1.9	.6
North Carolina	3.5	3.0	2.5	.1
North Dakota	5.1	4.0	2.8	.2
Ohio	3.0	2.5	1.2	.1
Oklahoma	3.4	2.7	1.3	.1
Oregon	2.5	2.4	1.9	-------
Pennsylvania	3.4	3.1	1.1	.2
Rhode Island	2.4	4.0	2.2	1.6
South Carolina	3.1	1.8	2.0	.1
South Dakota	4.2	2.9	2.3	-------
Tennessee	2.8	2.5	1.3	.7
Texas	3.5	1.5	1.1	.4
Utah	3.4	1.6	1.5	.1
Vermont	3.0	3.4	1.3	.1
Virginia	2.9	2.0	1.4	-------
Washington	2.8	2.4	3.7	.5
West Virginia	2.7	1.4	1.9	-------
Wisconsin	3.8	2.7	2.7	.3
Wyoming	3.6	2.5	1.8	.3
Alaska	1.3	-------	.5	-------
Hawaii	2.3	1.9	5.1	.4
Puerto Rico	2.6	1.0	.7	.1
Virgin Islands	-------	-------	-------	-------

[1] As set by Title VI, Public Health Service Act. [2] Per average annual death from tuberculosis.

SOURCE: 1951 State Plans for Hospital Construction.

achieving coordination between curative and preventive services. In smaller communities, there is a growing conviction that a health center can be housed in the building with the local hospital, if there is only one hospital in the community. In the larger communities, health centers, combining a great many different functions, are being built as separate units. At the close of 1951, a total of 323 health centers had been approved for construction under the Hill-Burton program, including the 46 to be combined with general hospitals.

The standard for public health centers set forth in the Hill-Burton Act is 1 health center per 30,000 population, except in States with a population density of less than 12 persons per square mile, where the ratio is 1 health center per 20,000 population. On this basis, the estimated need is for more than 5,000 additional health centers.

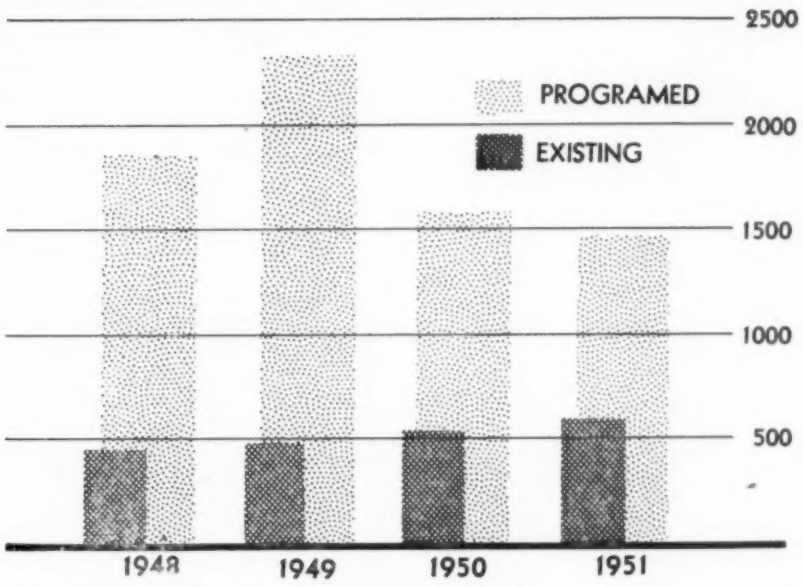


Figure 3. Public health centers programed and existing, United States, 1948 to 1951.

Since 1948 the States have planned the construction of about 1,500 health centers (fig. 3). State plans show a total of 590 public health centers now in existence. New construction is beginning to provide specially designed quarters for health centers formerly housed in inadequate and inappropriate quarters.

Refresher Course in Epidemiology for Public Health Nurses

A refresher course in communicable disease, with emphasis on the knowledge and skills necessary for field investigation of major communicable diseases and disease outbreaks, will be offered by the Communicable Disease Center, Public Health Service, Atlanta, Ga., May 12–30, 1952. Field experience in communicable disease investigations will be available, to a limited number of students, at Jackson, Miss., in cooperation with the Mississippi State Board of Health, June 2 to August 2, 1952.

Those eligible to enroll in the course include public health nursing supervisors, educational directors, coordinators, qualified public health staff nurses, and communicable disease nursing instructors in schools of nursing. Applicants must be recommended by their State Public Health Nursing Director or by an appropriate Federal official.

Application should be made through the State Public Health Nursing Director and the Regional Public Health Nursing Consultant and should be addressed to: Medical Director in Charge, Communicable Disease Center, Public Health Service, 50 Seventh Street, NE., Atlanta 5, Ga., Attention: Chief Nursing Consultant.

PHS publications

Medical Group Practice In the United States

The data in this publication were obtained from a survey initiated by the Public Health Service in 1945 and conducted with the cooperation of most of the medical groups in the country. The report is a summary of recent published material and supplementary unpublished data on fees and volume of work. It is largely restricted to the quantitative aspects of medical group practice. It deals with the development and trends of group practice, reporting on personnel and organization, administration, income, prepayment plans, fees, and volume of work. The statistical material is based upon a questionnaire survey of all listed medical groups in the United States in 1946, an intensive study of 22 selected medical groups, and an additional 80 groups which were visited briefly.

Hunt, G. Halsey, and Goldstein, Marcus S.: Medical Group Practice in the United States. (Public Health Service Publication No. 77.) 1951. 70 pages. From the Superintendent of Documents, Government Printing Office, Washington 25, D. C., 25 cents.

The National Health Survey, 1935–36—Scope, Method and Bibliography

Continued interest in the National Health Survey of 1935–36, and requests for information on the methods used in its house-to-house canvass of some 700,000 households, have made it necessary to reissue "The National Health Survey; Scope and Method of the Nation-Wide Canvass of Sickness in Relation to Its Social and Economic Setting." This paper, which was first published in *Public Health Reports* in 1939, comprises part I of this new publication. Part II is a comprehensive list of references, briefly annotated, to some 180 reports and articles which present descriptions or findings of the survey and which have been published over more than a decade in many different journals and bulletins.

• • •

The National Health Survey, 1935–36—Scope, Method, and Bibliography. Public Health Bibliography Series No. 5. (Public Health Service Publication No. 85). 1951. 67 pages. From the Superintendent of Documents, Government Printing Office, Washington 25, D. C., 30 cents.

Monthly Vital Statistics Report

The *Monthly Vital Statistics Report*, a new publication of the National Office of Vital Statistics, Public Health Service, will replace three current publications, *Monthly Marriage Report*, *Monthly Vital Statistics Bulletin*, and *Current Mortality Analysis*. Starting with data for January 1952, it will contain monthly and cumulative figures on births, marriage licenses, deaths, and infant deaths for States, certain cities, and Hawaii, and on marriage licenses for major cities, with a brief analysis of these vital statistics. The first issue will carry divorce data for a limited number of States and Hawaii, starting with figures for December 1951.

In addition, the new report will contain death rates by cause, age, race, and sex estimated from the returns of a 10-percent sample of death certificates filed in State and independent city vital statistics offices. The first issue will present these preliminary death rates for the United States for December 1951 and the year as a whole, with an analysis of current mortality conditions.

Volume 1, No. 1, of the new series will be published in March 1952.

The mailing lists of the three merging periodicals are being combined for the new *Monthly Vital Statistics Bulletin*. Requests to be placed on the lists should be addressed to the National Office of Vital Statistics, Public Health Service, Washington 25, D. C. Requests should include a statement as to how, by whom, and to what extent the publication will be utilized.

Cancer Morbidity Series

This series represents the first publication of comparative cancer morbidity data for 10 major cities in the United States. A decade ago the initial studies were published in *Public Health Reports*. The material was gathered during 1937–39. The data in the current series were collected during resurveys in 1947 and 1948.

The first three studies in the current series, published in 1950 and 1951, are on Atlanta, Ga.; San Francisco and Alameda Counties, Calif.; and New Orleans, La. The other seven cities under study include Birmingham, Ala.; Dallas, Tex.; Denver, Colo.; Chicago, Ill.; Detroit, Mich.; Pittsburgh and Philadelphia, Pa. The individual reports on each city will be followed by a United States summary.

Each report includes statistics on the number of cases reported and the completeness of reporting, and on the source and accuracy of reports. Incidence, prevalence, and mortality rates are given, as are relative frequencies by sex, age, and color. Figures are given on the stage of the cancer at diagnosis, time of hospitalization, mortality rates, survival prospects, and medical check-ups.

• • •

Cancer illness among residents in Atlanta, Georgia. Cancer Morbidity Series 1 (Public Health Service Publication No. 13) 1950. 43 pages; tables. (Not for sale.)

Cancer illness among residents of San Francisco and Alameda Counties, California. Cancer Morbidity Series 2 (Public Health Service Publication No. 65) 1951. 46 pages; tables. (Not for sale.)

Cancer illness among residents of New Orleans, Louisiana. Cancer Morbidity Series No. 3 (Public Health Service Publication No. 67) 1951. 52 pages; tables. (Not for sale.)

U. S. GOVERNMENT PRINTING OFFICE: 1952